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Educator Responses to Technology Influences in a 1:1 Laptop Middle School

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EDUCATOR RESPONSES TO TECHNOLOGY INFLUENCES

IN A 1:1 LAPTOP MIDDLE SCHOOL

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A DISSERTATION

Submitted in Partial Fulfillment of the

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ACCEPTANCE STATEMENT

On behalf of the Graduate Committee for David C. Boardman, I affirm that this manuscript is the final and accepted thesis. Signatures of all committee members are on file with the Graduate School at the University of Maine, 42 Stodder Hall, Orono, Maine.

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An Abstract of the Dissertation Presented
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Across the globe, students learn with digital texts, classrooms connect through the world-wide web, and elementary students apprentice in highly technical skills such as moviemaking or animation. As education embarks on the second decade of the 21st century, technology is becoming more sought after than ever before as countries prepare their youth for the future. But educational technology initiatives could easily leave learning stagnant and waste millions of public dollars if not designed and implemented in ways to create transformative learning experiences to prepare youth for today's highly collaborative digital world. This study investigates how teachers view various influences encouraging or discouraging the use of technology in the classroom, particularly in ways that transform education to a constructivist, innovative experience.

This qualitative study uses cultural historical activity theory as a conceptual and analytical framework, enabling the identification and analysis of various pressures on classroom educators to either incorporate instructional technology in their classroom practice, or work in opposition to its integration.

Data was collected through field observation and interview and was analyzed by identifying the source of influences from community, technology, instructional, curricular, administrative and classroom-based origins. Participants said they were more likely to integrate technology when receiving strong technical and pedagogical support through intervention of a technology integration specialist, support from professional relationships, positive student responses and levels of engagement, and a visible benefit to instruction.

This study analyzes the perceptions of a small group of participants with varying levels of experience in a 1:1 computing environment. Future studies could focus on the role of the technology integration specialist as a pedagogical and technical support for classroom educators. Additional studies could expand the research by evaluating other models of technological and pedagogical support in 1:1 environments.

DEDICATION

This dissertation is dedicated to Shirley, my wife, and our children, Van, Cooper, and Sophie, for endlessly supporting me as I worked toward this goal.

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A number of individuals guided me through this research process over the course of several years, and without their guidance, support, and assistance I would have been unable to complete this work.

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I am also deeply grateful to the staff of Coveside Middle School for welcoming me into their classrooms and giving up hours of personal time to talk about education and their practice. I am indebted to them for sharing their ideas and experiences.

I am also indebted to members of my dissertation committee for their insights on this study, from its design to final publication. Their guidance helped me see new possibilities and audiences for this work. I am particularly indebted to Susan Bennett-Armistead for her encouragement, advice on the study's design, and guidance in the development of my analytical procedures.

Finally, I would like to thank my wife, Shirley, and our children, Van, Sophie, and Cooper. Their love, patience and support as I moved from stage to stage in my research and doctoral work encouraged me to continue through those moments when this goal seemed unattainable.

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CHAPTER 1: INTRODUCTION

A typical day after school for my three children looks something like this:

My eldest, 12, teaches himself the basics of computer programming on a Linux-based laptop designed by an MIT professor for children in the developing world. He learns by experimentation, writing basic code to alter programs, speed the machine's performance, and change its appearance. Other times, he uses an online virtual flight environment to study for his pilot's license, or plays a new app just downloaded for the iPod he's figured out how to customize.

His younger brother chats with friends in an online social network, writing back and forth with pals from school and their extended friends through his Webkinz or Club Penguin accounts. He routinely uploads photos of his sci-fi Lego creations to a site where other children vote on their favorites, securing an online audience and validation of co-creators, like-minded, anonymous fans. Frequently, he checks his YouTube channel to gauge the popularity of his self-created stop-motion Lego films, a popular genre for pre-adolescent boys.

My 11-year-old daughter listens to the music she downloaded (legally) from the Internet. Her FIRST Lego robotics team just completed a successful season; she and her all-girl team researched the impact of climate change on girls and women in the developing world, and then created a short film that profiled their ideas about growing up in a media culture obsessed with fashion and body image. They are powerful, revolutionary ideas for a group of fifth grade girls bombarded by media stereotypes, but their film was never seen by her classmates; outdated school equipment was unable to play DVDs.

These are children actively taking part in today's participatory culture (Jenkins et al., 2007), using new media and collaborative, interactive technologies and networks to access audiences, mentors, and resources where they develop a public presence and shape their own persona. Their lives out of school are similar to those of other young people today; they access audiences as a matter of course, sharing ideas, seeking social approval, and developing connections that might be built on pseudonyms and last just moments, but are connections nonetheless (Ito et al., 2008; Jenkins et al., 2007).

Contrast these images with a snapshot of their school day. My oldest son attends a middle school where a laptop computer is provided for each student, a scenario called 1:1 computing. On a typical day, he will use his Apple MacBook in mathematics for 30 minutes in an online program that replaces in-person teacher instruction with a level-based tutorial approach. His math class is absent of manipulatives, projects, real world connections or authentic problems; his teacher works under a directive she interpreted as requiring 150 minutes a week of online instruction, and when technical problems cause outages of the program or students miss school, the sessions are doubled until the requisite time is accumulated. There is little opportunity left for face-to-face instruction.

In a language arts class, his teacher encourages him to create a short film as a visual book report, an engaging assignment with all the earmarks of scaffolding his literacy instruction, but then mistakenly deletes the file in her attempt to view it. His work, produced over several days, is never seen, and the grade for the work is waived.

At their elementary school, my younger children are typically allowed 55 minutes per week on school computers, a session arranged as an opportunity to give their elementary teachers a much-needed planning period to ready for the return of their 25 students. The computer time is spent under the watch of a technician monitoring use of a variety of "edutainment" websites, usually with no connection to the work in their regular classroom, or to the world outside. Computer-time is an indoor, nonactive recess, but rather than playing noisily with their friends, they make digital creatures race across their screens, gobble up glowing letters, or built medieval castles and blow them up.

The experiences of my children are microcosmic of the contrast between schoolchildren's use of technology within the school day, and their active involvement with it outside of the educational institution where they create, share, communicate with relatives and friends around the world, and steadily experiment (Ito et al., 2008). Their interactions with educational technology, and those of the students I encounter each day at the high school where I teach, provide the impetus for this research.

Problem Statement

My study investigates why it is that some teachers rapidly and readily employ technology, others attempt and then cease its use, and still others shun the idea of technology in education altogether. I focus on a central question: ***How are educators' decisions to integrate technology in a 1:1 laptop middle school shaped by their perceptions of internal and external influences from students, community, colleagues, and administration?*** The focus of this research lies in identifying and analyzing the effects of these pressures on classroom educators, professionals who will either develop successful measures to incorporate technology in their instruction, relegate its use to an "edutainment" filler, or ban its use altogether.

Educational computing in middle schools in the state of Maine has been a standard for nearly a decade since former Gov. Angus King launched a program in 2002 that aimed to provide every child in grades 7-8, and their teachers, with a laptop computer. Basing my research within this atmosphere, I offer insights applicable for the growing number of learning centers in the United States and abroad, both public and privately sponsored, instituting programs to provide extensive access to instructional and learning technology, not just computers but interactive whiteboards, mobile devices, and other approaches. This research is about perceptions, and my central question has implications for professional development, the ways in which teachers change practice or remain linked to traditional instructional methods, and the current call for educators to incorporate the critical skills and technological literacies of the 21st century into current classroom teaching.

Research Basis for Technology in Education

It is important in exploring the details of this study to start with a premise: technology is a critical factor in what it means to be educated today (Jonassen, Howland, Moore, & Marra, 2003; Prensky, 2001; Warschauer, 2003, 2006). A broad scope of research that I will discuss in Chapter 2 links effective technology integration with improvements in motivation and engagement, critical thinking, reading, quality and amount of writing, mathematics, and science. That research has guided the Maine initiative as political and educational leaders, working on the impetus of research from Papert (1993), have provided the financial and political support to provide computers to all children first in grades 7 and 8, and later expanding to all students through grade 12.

Papert, a pioneer in educational computing, researched middle school aged and younger children’s interaction with self-created, technology-based learning environments. His work demonstrated that strong learning achievements could be made through a purposeful use of computers when learners used basic design principles of artificial intelligence to create simple, and by today's standards, rudimentary, video games. Papert's observations (1993) led him to believe that computers would not only improve achievement, but change the way thinking and learning occurs. Papert (1993) explains:

> Video games teach children what computers are beginning to teach adults - that some forms of learning are fast-paced, immensely compelling, and rewarding. The fact that they are enormously demanding of one's time and require new ways of thinking remains a small price to pay (and is perhaps even an advantage) to be vaulted into the future. Not surprisingly, by comparison 'School' strikes many young people as slow, boring, and frankly out of touch. (p. 5)

Papert's work was the fundamental theoretical underpinning behind the development of the Maine Learning Technology Initiative, and it set an early framework for future research in educational computing, a tradition my study attempts to continue through an examination of three Maine middle school classrooms.

A National Call

Initiatives similar to Maine's have taken hold in other states, Virginia, Idaho, Hawaii, and South Carolina among them, as well as in other countries around the world. Continuing support for the Maine project – as well as others – comes not only through the research provided by a variety of studies that I will discuss in Chapter 2, but also through the National Educational Technology Plan (NETP). That blueprint calls for technology to take an integral role in American education to help create rich opportunities for collaborative learning, authentic experience, student-centered instruction, heightened engagement, and broader access to resources and other sources of guidance from outside the classroom (U.S. Department of Education, 2010). The national report identifies educational technology as not only something that expands access to information, but access to society as well. NETP (2010) explains:

> Today, low-cost Internet access devices, easy-to-use digital authoring tools, and the web facilitate access to information and multimedia learning content, communication, and collaboration. They provide the ability to participate in online learning communities that cross disciplines, organizations, international boundaries, and cultures. (p. 7)

NETP also calls for educators to employ technology to metaphorically open the doors of their classroom to outside avenues for students to pursue knowledge, and urges them to change what they teach within the classroom and how they teach it. The shifts are driven by the need to match learners with skills needed to succeed in today's world, no matter what subject, according to the report. NETP (2010) explains:

> Whether the domain is English language arts, mathematics, sciences, social studies, history, art, or music, 21st century competencies and expertise such as critical thinking, complex problem solving, collaboration, and multimedia communication should be woven into all content areas. These competencies are necessary to become expert learners, which we all must be if we are to adapt to our rapidly changing world over the course of our lives, and that involves developing deep understanding within specific content areas and making the connections between them. (p. 4)

Technology as Access and Participation

In addition to access to information, students using technology find access to other, non-official teachers and mentors, as well as teachers in other schools or even countries. Those “experts” might range from other students to knowledgeable professionals who offer answers to questions directly posted to forums about online games, offer advice through commercial sites like About.com, or simply provide feedback on a photo posted to Fickr, the online photography sharing site. Sometimes students actively seek out those experts, and other times students become the experts themselves; either way, the Internet provides learners with teachers outside of classroom constraints and physical zones of contact (Ito et al., 2008).

Technology in education also offers students the opportunity to join what Jenkins et al. (2007) term today’s “participatory culture.” They argue that the conversation of a digital divide needs to shift from one focused on technological access, the traditional haves vs. have-nots, to a focus on those who are allowed to participate in our technology-based modern culture, and those who are not provided with “opportunities to participate and to develop the cultural competencies and social skills needed for full involvement” (p. 4) in society. Jenkins et al. (2007) explains:

> The school system’s inability to close this participation gap has negative consequences for everyone involved. On the one hand, those youth who are most advanced in media literacies are often stripped of their technologies and robbed of their best techniques for learning in an effort to ensure a uniform experience for all in the classroom. On the other hand, many youth who have had no exposure to

these kinds of participatory cultures outside school find themselves struggling to keep up with their peers. (p. 13)

In an age where conversations take place on Facebook, Twitter, and even the primary-grade social network Webkinz – where information is shared on wikis and blogs, where political candidates seek out constituents on YouTube and other social media portals, teachers become gatekeepers to the marketplace of ideas. Allowing technology use as part of classroom instruction provides an educational avenue to that marketplace; preventing it disallows that freedom and strips away that right to participate in society (Jenkins et al., 2007). That makes this study an important one, since it is not just about effective instructional strategies or teaching approaches; it is instead, in part, about access to participation – both as recipients and contributors – to the elemental components of the mass culture.

A Pathway to New Literacies

Access not only provides an avenue to popular culture, but also the additional learning resources and multitude of potential teachers beyond the traditional one in the classroom, a trait of the online communities accessible through technology (Ito et al., 2008). That widening of the scope of information and resources coincides with a shift in what it means to be literate, what we define as text – as diverse as anime, essay, rap, video and beyond – and the requirements needed to access and navigate those new texts, essentially, changing the definition of literacy from the ability to interact with and navigate text to discover or create meaning to something much more. Literacy today is about knowing how to read a range of texts that did not previously exist with solely print technology, and knowing how to navigate texts with nonlinear, multilayer designs that may not exist in a traditional single location. Navigating “new literacies” is often about knowing how to know (Coiro, Knobel, Lankshear, & Leu, 2008). The authors (2008) explain:

> Thus, literacy acquisition may be defined not by acquiring the ability to take advantage of the literacy potential inherent in any single, static, technology of literacy (e.g. traditional print technology) but rather by a larger mindset and the ability to continuously adapt to the new literacies required by the new technologies that rapidly and continuously spread on the Internet. Moreover, since there will likely be more new technology than any single person could hope to accommodate, literacy will also include knowing how and when to make wise decisions about which technologies and which forms and functions most support one’s purposes. (p. 5)

Educating today’s students to become savvy in new literacies and the skills necessary to negotiate what are evolving components is one deemed of such importance by the crafters of the nation’s educational technology plan (U.S. Department of Education, 2010) as to call for “revolutionary transformation, rather than evolutionary tinkering” (p. 3) of the current system of instruction to increase the use of technology in the nation’s schools.

A New Way of Teaching

That call for teachers to shift from traditional modes of instruction to ones that activate students through the incorporation of technology requires that teachers learn new ways of helping students learn (Baylor & Ritchie, 2002; Blin & Munro, 2007; Jonassen, Howland, Moore & Marra, 2003; Lim & Hang, 2003). My study, one that is based in the dialogue of educators and the impact of influences they encounter, offers new insights into what teachers say about professional development and its influence on their use of technology. That kind of understanding, coupled with an overall view of the widespread influences impacting technology adoption, provides a window into the environment created through widespread computing with both explicit and implicit pressures. Once identified, those experiences could be mediated to create technology adoption scenarios that maximize effective teaching and what Jonassen et al. (2003) term "meaningful" learning. The tenants of the national technology plan echo the ideas of constructivism put forward by Jonassen et al. (2003) of five hallmarks of meaningful learning, that it is active, constructive, intentional, authentic, and cooperative. Jonassen et al. (2003) explain: "Technologies afford students the opportunities to engage in meaningful learning when used as tools for constructing, testing, comparing, and evaluating models of phenomena, problems, the structure of ideas, and the thought processed engaged in their creation" (p. 8).

Research Frame

Integration

The integration of information and communications technology (ICT) in the service of literacy instruction is not solely dependent on a teacher's best intentions, technological capability, pedagogy, or even access to equipment, but on a vast array of implicit and explicit factors, both inside and outside the classroom (Brown, & Warschauer, 2006; Levin & Wadmany, 2008; Scott & Mouza, 2007; Warschauer, Grant, Del Real, & Rousseau, 2004).

Some educators, members of the “digital immigrant” generation (Prensky, 2001, p. 2) come to the idea of accepting or using technology as new arrivals to a foreign land and are themselves unable to perform tasks that are seen as simple within the “digital native” (p. 1) culture: saving an email attachment, connecting an LCD projector, texting with a cell phone. As I’ve seen from colleagues and my children’s teachers, all operating within teaching environments where computers are present for every learner – deemed “ubiquitous computing” by Dwyer (1994) – some responses to educational technology include refusing to recognize its existence or banning it outright. Far from digital immigrants, these educators fail to even acknowledge the immigration. Others are less recalcitrant and experiment with the technology, even attempting to incorporate the tools and techniques in their students’ learning, but often in a cursory way, allowing the word processing of a final draft of an otherwise handwritten essay, or bypassing print volumes in the school library for a search on an Internet database instead. And in other instances, education policymakers create programs to increase the use of education technology, but do so in a way that thwarts the ultimate goal, an increase in student learning. Those missteps can range from inadequate network design or enacting evaluation procedures or restrictions on use, among other moves, that can stifle innovative approaches.

Integration Successes

At times, teachers find successful ways to incorporate the technology in a way that supports learning. Some do so because they are experimenters themselves, offering their students new ways to engage with and respond to reading and writing. Others sense the potential approval from administrators eagerly embracing digital age learning and looking for a return on a massive investment of public funds, and still others because perhaps they sense the eagerness of students who in so many other matters relating to school, find they must unplug and disconnect from the digital world they inhabit when they arrive. Yet another population has on occasion adopted technology - perhaps even as pioneers in their school, only to then discontinue its use and return to traditional methods of instruction. Lee (2006) reported that such observations are not uncommon. In spite of research supporting the use of technology, studies indicate reluctance from teachers to incorporate technology tools in ways that meaningfully alter the educational experience to one offering greater participation, as called for by Jenkins et al. (2007). Lee identified three myths educators commonly subscribe to: ICT having limited value, providing a quick, all encompassing fix for learning problems, and requiring a need for overwhelming technical knowledge. As Lee (2006) explains:

> Unless teachers are willing to dispel their beliefs which are often embedded in traditions of teaching and learning where conventional uses of computer technology are inconsistent with the current reform approaches and current views on teaching and learning, then any interventions by these teachers will not achieve true ICT integration in their classrooms. (p. 209)

While my research tells the story of just a small number of teachers, their stories offer meaningful glimpses into the realities of technology integration so that administrators, policymakers, and others might understand why some teachers remain uncommitted to the idea of technology integration, while others embrace it. Their insights will help program designers and implementers, education supervisors, and others glimpse one more piece of the dynamic that occurs inside the nation's classrooms.

Research in a Historical and Pedagogical Context

This study comes as one piece of an evolving answer to the question of what drives successful technology integration, not just in classroom instruction, but in work that meaningfully serves students' literacy advancement. Over a decade ago, when the idea of providing a computer for every student, 1:1 computing, was in its infancy, Heppell (1998) warned that schools which shirked technology would do their students a massive disservice, failing to prepare them for what has become a necessity – the ability to navigate changing definitions of literacy and changing modes of learning. Heppell (1998) explains: "A text-based curriculum built around individual endeavor would arguably produce dysfunctional learners in a technological world, which is a highly controversial conclusion to emerge from the promise of multimedia technology" (McCormick & Scrimshaw, 2001, pp. 8-9).

Effective Technology Integration

In spite of the investment of millions of dollars in educational technology, school has not changed much from the traditional mode for many students (Papert, 1993; Jonassen et al., 2003; Lim & Hang, 2003; U.S. Department of Education, 2010), but a contingent of researchers argue that it should. Their work provides data that links effective technology integration with higher reading scores, greater achievement in science and mathematics, increases in critical thinking skills, and stronger engagement in learning (Papert, 1993; Heppell, 1998; Blin & Munro, 2007; Jenkins et al., 2007, Tam, 2009).

But for some children, work is done on paper, and a typical day's tasks can at times include traditional activities such as worksheets, summary questions at the conclusions of textbook chapters, even the periodic crossword puzzle or word search. Frequently, teachers make well-intentioned attempts with technology, but at least for my children, and some of the students I see each day, those efforts rarely move beyond the level of what Puentedura (2008) calls substitution – a computer is merely used to type a final piece of writing, or a teacher lectures with information presented via PowerPoint instead of chalk and board. The essence of the work is unchanged; there is no transformation into something bigger, transformative, what Engeström (1999) terms "expansive."

At times, those efforts to use technology complicate traditional modes of teaching – a teacher-directed pedagogy – with additional work, but with no apparent benefits. A worksheet that was once distributed via photocopier, completed by students and then graded by a teacher is now digitized from a paper original, uploaded into a secure online forum where students download it to their computers, fill in the blanks, upload it to a teacher's portal where they are processed and returned. Instructional use of technology has not transformed their educational experience into something more constructivist, active, participatory, or exploratory. Kent (2000) gives one picture of what that transformation might look like in *Beyond Room 109: Developing Independent Study Projects* with a picture of his own English classroom as a place where students learn through reading, writing, and creation of authentic experiences and projects. Kent (2000) explains:

> Many would call my classroom approach a Constructivist pedagogy where I "encourage and accept student autonomy, where raw data and primary sources (rather than textbooks) are used in investigations, where student thinking drives the lessons, and where dialogue, inquiry, and puzzlement are valued" (Brooks & Brooks, viii, 1993). I agree. (pp. 24-25)

But in spite of the massive infusion of information and communications technology in schools, researchers and proponents of the educational transformation promised by an infusion of 21st century learning tools routinely lament the overall lack of change to accompany the growth of computers in the classroom (Blin & Munro, 2007; Lee, 2006; Papert, 1993; Zhao, 2003). The experience of many children has not been transformed in the frame of Christensen's (1997) idea of disruptive innovation, where the basic system or approach to learning has been radically altered. This comes in spite of research that today's students need skills and experiences that can be developed by a pervasive use of technology (Ito et al., 2008; Jenkins et al., 2007; U.S. Department of Education, 2010). Blin and Munro (2007) view that idea of disruption as "a serious transformation or alteration of the structure of teaching and learning activities" (p. 476), a change that would meaningfully alter the current mode from one of delivery to one of discovery. In many places within the world of school, that has yet to happen.

Those changes are descriptive of a meld between classroom learning and access to our "participatory culture" (Jenkins et al., 2007), of constructivist education where learning lies in the creation of understanding (Brooks & Brooks, 2001). These are examples of Christensen's (1997) disruptions: children will collaborate online with other learners to create, edit, and publish documents, websites, animations, and media that never actually exist on their own or school computers (Friedman, 2005; Ito et al., 2008; Jenkins et al., 2007; Johnson, Smith, Levine, & Haywood, 2010; Jonassen, Howland, Moore, & Marra, 2003). They will create, play, and share games that teach, share experiences, or solve real problems in virtual space, learning anywhere at anytime via mobile devices. They might even live and play in augmented reality – a *Tron*-style world typified by the Hewlett Packard (2007) concept marketing video, *Always Connected: Roku's Reward*, in which a group of boys use their handheld gaming devices to play in a reality morphed between the actual, populated streets of their city and the virtual world of the game, animation layered on top of reality (Johnson, Smith, Levine & Haywood, 2010).

Today, effective technology use in schools might look something like this:

- A traditional English class essay becomes the genesis for a multimedia digital story where images are created or selected to enhance narration. What was once an exercise in verbal communication now becomes one in which a writer must communicate and engage via multiple senses, enhancing meaning and potentially broadening audience.
- Elementary writers create their own books using a simple editing program. They follow a writing process from drafting to publication and then share their creations with a neighboring class.
- A science student studying the vulnerability of ecosystems creates an interactive graph; rather than memorizing average rates of transmission of a virus within a closed system, she employs mathematics, research, and basic programming to create a dynamic animation that demonstrates the invasion of the foreign cells and

the subsequent demise of the unprotected community. The work can now be replicated and altered for even hypothetical “invaders” in unknown environments with dramatically different conditions, making the learning transferable and alterable for varying scenarios.

- Language arts students exchange descriptions of their lives with teenagers in Gaza; they talk in real time – via writing and Skype – about the role of the United Nations and U.S. as arbitrator of the Palestine-Israel conflict.
- Students explore world history by creating an imaginary society, using the social networking site Twitter and mobile phones to barter as they understand the influences of wealthy, aggressive groups and the potential submission of less affluent, more passive cultures (Wesch, 2008).

These are some of the possibilities of the disruption created through expansionist learning where activities – in this case learning activities – are transformed through the application of a variety of tools, influences, and actions to create a changed and “expanded” experience that uses acquired knowledge to demonstrate learning (Engeström, 2001).

Study Specifics

My study examines perceptions of the person often directly responsible for employing technology use, the classroom teacher. Through this research, I identify, examine, and analyze the pressures and contradictions, or opposing forces, to use the language of my conceptual and analytical lens, cultural-historical activity theory, that shape the perceptions of those ultimately in a position to incorporate technology at the classroom level. The participants of this study represent a diverse group of educators practicing within a 1:1 laptop school. Some are innovators; in their classrooms students correspond with children in other countries, build online games and share their ideas through self-created video. Others are new adopters; they have changed practices only within a few years, increasing their use of instructional technology slowly. They work surrounded by technology in a building where the principal posts to a school information Twitter page, uploads monthly podcasts to a school website, and displays the latest in gaming technology on opening parents' night. Their stories offer a range of insights into what drives the integration of technology, why some teachers move easily toward a computer-intensive instruction and others are tentative or reluctant. I discuss the educators taking part in this study in Chapter 3, as well as my rationale for both their selection as participants and their school as a site for this study.

Issues of Change: Teacher Intentions and Influences

Teacher practice and the role of perceptions either as a provocateur, or as barrier to change are focal points of this study. Even as a teacher myself, highly aware of the need to alter teaching strategies to help prepare youth for the technology-based world in which they live, my own instruction can vary from the highly collaborative, technology-based lessons that open my classroom and students' lives to real world skills and possibilities, to something as disconnected as a timed writing prompt, utilizing a prepared question that has little to do with the reality of my students, and mandating the use of pens and paper over the school-provided laptops sitting in backpacks at their feet. I come to this study as a classroom teacher recognized by the National Writing Project and other organizations for creative use of instructional technology that advances students' literacy achievement and ability to creatively solve real-world problems, as well as occasionally challenged by peers who ignore research that supports technology as a critical tool for student learning today. The well-intentioned work of teacher preparation programs that require pre-service educators to purchase platform-specific computers (Pooler, 2009) and take specialized courses in technology integration can easily be undone when educators face leadership that does not support technology in the classroom.

I am cognizant that a supervisor's disapproving glare, curricular pressure, student behavior problems, technical issues, or even a student's heightened level of motivation when technology is incorporated into the work of our classrooms can either hamper its inclusion or expand its use. This study, and my own perspective as a researcher, is influenced by those pressures, and that makes me cognizant of some of the influences participants in this study face. As a parent, educator, and researcher I have had multiple opportunities to explore the problem of how a variety of pressures converge around integration of technology, potentially driving ahead its implementation and the transformation of traditional teaching, or solidifying approaches that reinforce the "banking" (Freire, 1970) model of traditional education. As Freire (1970) explains:

> Education thus becomes an act of depositing, in which the students are the depositories and the teacher is the depositor. Instead of communicating, the teacher issues communiqués and makes deposits which the students patiently receive, memorize, and repeat. This is the "banking' concept of education, in which the scope of action allowed to the students extends only as far as receiving, filing, and storing the deposits. They do, it is true, have the opportunity to become collectors or cataloguers of the things they store. (p. 72)

Freire's challenge to the traditional, teacher-centered mode of education with student as passive recipient is an early call for disruptions now offered by the potential of technology today.

Viewing integration of technology through the converging lenses of parent, teacher, participant, and researcher has made apparent the range of both real and perceived pressures on educators attempting to employ technology in the institutional setting of public school, an open system subject to the dynamics of both external and internal pressures (Banathy, 1992; Hoy & Miskel, 2005; Senge 1994). Teachers within these systems are subject to internal pressures as implicit as students expecting the school experience will mirror that of their already highly connected world, to those as explicit as the external state or local mandates demanding a return on the tremendous investment in technology, or a failure to acknowledge technological incentives to improving student learning. Those driven to use computers may encounter encouragement, or even resistance from administrators; colleagues may likewise provide nurturing, beneficial support, or may deliver intimidating, crippling opposition, a psychologically triggered defense against change or the perception that one educator has moved too far ahead of the pack (Baylor & Ritchie, 2002; Levin & Wadamy, 2008; Papert, 1993; Tam, 2008).

This all comes as educators face pressures such as an increased focus on student testing and a demand for results-based instruction. But this same era also provides a wealth of research providing strong support for matching teaching styles to learning behaviors (Farkas, 2003; Gulek & Demirtas 2005; Kumar & Wilson, 1997; Zhao & Frank, 2003) and the integration of technology as tools for engaging learners and raising student achievement.

Numerous studies have reported various rates of success in raising the degree of educational technology integration, including professional development (Hill, 2007; Scott & Mouza, 2007; Zhao & Bryant, 2006), pre-service teacher preparation (Barron & Goldman, 1994; Brown & Warschauer, 2006; Yeh, 2006), mentoring (Baylor & Ritchie, 2002; Levin & Wadmany, 2008; Lloyd & Cronin, 2002), and increased access to equipment (Vrasidas & Glass, 2007), but the answer remains incomplete. Frequently, results of intervention seem to show little progress in convincing teachers to integrate technology in a way that transforms the educational experience from a teacher-centered to learner-centered model (Blin & Munro, 2007; Windschitl & Sahl, 2002; Zhao & Bryant, 2006). As one example, Zhao and Bryant reported on a study by DiBenedetto (2005) finding that teachers who took part in a technology integration training program demonstrated positive attitudes toward using computers in education compared to teachers who had no training, but still failed to "show significant changes in frequent classroom integration of technology with students and more student-centered learning" (p. 54).

Study Relevance

The location of this study has relevance beyond the walls of this one building. Coveside Middle School (a pseudonym) is located within a district that, like dozens of others in Maine, has been part of the Maine Learning Technology Initiative (MLTI) program that has provided Apple MacBook computers to all 7th and 8th grade students and their teachers since 2002. Those children are allowed to bring their computers home during the school year. Sixth grade students have 1:1 access to computers, and are assigned specific laptops at the start of the school year, but are not allowed to take those computers home. The trickling down of computers over a sustained time frame has allowed the Coveside district to provide a computer for each child in grades 5-12.

As a teacher at a neighboring school in the Coveside district, when this initiative spread to my high school building in 2008, I quickly found my students undergoing experiences that mirrored those of my own three children in their middle and elementary schools. Some students complained they were not allowed to use their computers by the most traditional teachers, and others found themselves overwhelmed by educators who tried a mélange of programs, websites, and projects that provided more distraction than learning. Watching a 1:1 laptop environment emerge around me at a cost of over $400,000 per year made it evident that the findings of this study could help district and state administrators understand one more component of how an investment in technology may or may not result in its direct implementation in the classroom.

Rationale

An understanding of what are often contradictory forces on classroom teachers provides an essential insight that may lead to development initiatives, training mechanisms or other measures to support teachers with the intent of enhancing or offsetting influences that might reinforce or deter integration measures. The in-depth glimpse at this target population is valuable for a range of intended users, including federal and state policymakers, program developers, implementers and funding agencies, administrators from the district to building level, technology coordinators and integrators, and advocates of technology integration and educational reform working in a nonprofit environment. These regulatory, policy development, and funding agencies are all ultimately dependent on the participation of classroom educators for program implementation. While observation and analysis of technology use, as well as students' academic results, can all provide an after-the-fact glimpse into the course of an initiative, an understanding of the dynamics of pressures to integrate technology both from within and outside the classroom could help shape initiatives and funding approaches at the design stage, reducing the likelihood that programs are evaluated on a trial and error basis.

The issue is at the forefront of educational reform with technology integration not only necessary as a tool for economic success of learners in a skill-competitive environment, but also as a tool for equity. As much of our economic, social, and civic society begins to function in the digitally connected world, those who are denied by lack of education, training, or privilege the opportunity to participate are disenfranchised from full citizenship (Jenkins et al., 2007; Warschauer, 2003).

At times, the schism between those educationally impoverished and wealthy is no more evident than through the lens of technology integration, visible through the activities of children. Success, even in challenging economic times, often is dependent on one's ability to use technology skillfully, to quickly learn new processes and programs, to adapt existing technologies to new, more fruitful uses (Ito et al., 2008; Jenkins et al., 2007; Lim & Hang, 2003; Papert, 1993; U.S. Department of Education, 2010; Warschauer, 2003, 2006).

Often, the justification for technology use in education is boiled down to the economic argument: our children need to master the tools of the 21st century to compete against the rising educated populations of India, China, and the other developing nations

(Friedman, 2005). In the reality of growing 1:1 computing programs and 99 percent of U.S. public schools wired to the Internet (U.S. Department of Education, 2009), the idea of the digital divide seems obsolete, and as schools ignore or disenfranchise the technology use of students outside of institution walls, banning them access to their social networking sites, even limiting access to cell phones, portable multimedia devices, schools have relegated participation in society to a permission-only basis (Ito et al., 2008).

Limits to Current Research

Surprisingly, in spite of the amount of research in educational technology and its implementation in schools around the world, published work focused on the unique environment created by Maine's laptop program is limited. Also, researchers have generally not focused their work on teacher perceptions in a 1:1 middle school environment, a key component of my study. Warshauer (2003, 2004, 2006) has examined the laptop initiative's impact on teaching and learning, drawing on similar programs in Hawaii and Virginia for a broader contextual range. Those studies found wide ranging increases in student achievement, as well as enhanced so-called 21st century skills: collaboration, creativity, critical thinking, and autonomous learning.

Warshauer, studying diverse 1:1 computing programs in California and Maine, found a greater quantity and higher quality of student writing, deeper levels of engaged learning, especially when multimedia was employed in the classroom or student assignments, and a heightened level of authenticity in learning when students learned with computers. While I will discuss additional research in more detail in Chapter 2, it is important to note that the issue of technology use in schools, supported by public policy and research on an international level, is validated as a strong instructional tool at the middle school level and as a learning environment where 1:1 computing is available.

Conclusion

As I have noted, a large bank of research has already shown the benefits of integrating technology in education, and a variety of studies have used cultural historical activity theory most recently redefined by Engeström (2001) to examine various pressures at work in educational settings. But a search of the literature reveals few studies that examine the influences and contradictions posed by local leadership, community stakeholders, instructional resources, and administrative policymakers on educators in a 1:1 laptop school. Stakeholders – students, parents, community members, colleagues, and others with an influence in the classroom – may often believe that the installation of a 1:1 technology program will mean the automatic conversion of paper-and-pencil learning to a constructivist, highly integrated practice linking students to learning experiences beyond the classroom walls. But as numerous researchers have discovered, that is not always the case (Lee, 2006; Lim & Hang, 2003; Tam, 2008; Warschauer, Grant, Del Real, & Rousseau, 2001; Warschauer, Knobel, & Stone, 2004; Windschitl & Sahl, 2002). The underlying question often centers on what happens when a classroom's door closes, and this study attempts to uncover through an examination of both activity and dialogue the pressures that shape the multiple outcomes possible.

This study started with a universal question: ***How are educators' decisions to integrate technology in a 1:1 laptop middle school shaped by their perceptions of internal and external influences from students, community, colleagues, and***

administration? In order to uncover answers to that overarching question, four sub-questions focused the inquiry:

- How do perceptions of expectations and pressures of community stakeholders (students, parents, community members) influence the integration of educational technology?
- How do perceptions of expectations and pressures from colleagues affect the integration of educational technology?
- How do perceptions of district and school-level administrative initiatives, policy directives and influences affect the integration of educational technology?
- How do perceptions of state-level initiatives, policy directives and influences affect the integration of educational technology?

Using the participant teacher as the central focus of the inquiry, I identify the influences within the educator's sphere of operations around the issue of the integration of technology, and his or her perceptions of those factors. An examination of the school, district, and state-based influences apparent to participants – ranging from the school principal's opening message to the school community, or state report on student literacy achievement, combined with direct observation and analysis of interview responses offers a picture of the influences apparent when teachers consider incorporating technology in classroom instruction as a tool for student learning.

This study, by focusing on the perceptions of classroom teachers, helps expand the current body of research, and its results will prove useful to those involved in the ongoing discussions of how extensively technology should be a component of instruction, and more importantly, why some teachers integrate technology in their instruction and students' learning while others do not.

Some researchers have found partial answers to this question exploring the scale of integration level among teaching practices, but that exploration has not always taken into account the factors covered by this study, the issue of teacher perception of internal and external influence from students, community, colleagues, and administration. Using the analytical lens of cultural historical activity theory, this study examines the sources of those perceptions, providing a key part of the story behind the employment of technology in educational settings, particularly with an eye toward those approaches that work toward transforming components of the existing Industrial-Age educational system into a post-modern, constructivist and literacy intensive approach to teaching and learning.

CHAPTER 2: THEORETICAL FRAMEWORK

Context

Since the advent of financially accessible computers close to three decades ago, researchers have examined the changes to teaching and learning created by the introduction of instructional technology. In dozens of studies, analysts have uncovered benefits and challenges regarding the use of computers for learning, probed leadership models for technology-based constructivist reform, and explored an array of issues tangential to my study. Numerous reports and published articles have concluded that in many significant ways, the introduction of instructional technology has been positive for student learning, and that research basis has lead the call for increased utilization of technology both as an instructional and transformative tool in education today (Gee, 2008, 2010; Jonassen, Howland, Moore, & Marra, 2003; Prensky, 2001, 2008; U.S. Department of Education, 2010).

This chapter will discuss results from the most relevant studies in an effort to help the reader understand the context of my study, and the potential it holds to advance the current body of research. My review begins with an overview of technology in education, a narrower focus on research in 1:1 environments in which each child is provided with a computer for school, a section on the role of educators and professional development in the integration of technology, and concludes with a review of research into the use of cultural historical activity theory (Engeström, 1987, 1999, 2001) as a conceptual framework for this study and as a lens to examine the role of influences from accessibility, curriculum, students, administrators, and other influential factors.

What makes my research different from the existing body of published work is a focus on teacher perceptions in an environment where all students are provided computers for virtually round the clock use, and where teachers have been able to experience an environment of such immersive computing over time. In Maine, the location of my study, students and teachers at Coveside Middle School (a pseudonym) have had access to such ubiquitous computing for a decade. Coveside presents a culture where technology use is commonplace, to a large degree. But it is also a place, like other schools around the country, where the opposing atmosphere can prevail at times, where computers can be banned from a classroom, or employed merely as replacement technology for pencil and paper, not providing a disruptive measure to the traditional practice. In one classroom, technology is transformative, yet in another, it is shunned. My study aims to explore why that dichotomy exists. Prior to unpacking this research, however, it is important to consider the larger context for my work, exploring in particular the rationale for instructional technology.

Technology in Education

Research using a variety of quantitative and qualitative approaches points to increased achievement scores and efficacy in writing (Goldberg, Russell, & Cook, 2003; Lenhart, Arafeh, Smith, & Rankin Macgill, 2008; Scott & Mouza, 2007) comprehension, application, and achievement in mathematics (Isiksal & Askar, 2005), inquiry-based science (Akpan & Andre, 2000; Bavraktar, 2001; Linn & His, 2000), and reading (Middleton & Murray, 1999; Sternberg, Kaplan, & Borcktitle, 2007). Additional research indicates that learner participation in computer gaming and learner creation of interactive video games have a positive effect on development of higher-order critical thinking skills, self-efficacy, and academic achievement in reading strategies and mathematics, and stronger academic motivation (Gee, 2008; Rieber, 2005; Robertson & Good, 2005; Rosas et al., 2003). Heightened motivation in learning has been tied to improved academic achievement, making the connection to technology a dual one (Gulek & Demirtas, 2005; Roderick & Engel, 2001; Roth & Paris, 1991).

Research also connects student computer access to academic achievement in instances when children have that access only during school hours, unlike round-the-clock access like that provided by the Maine laptop program in which students are allowed to take their computers home (Russell, Bebell, & Higgins, 2004). This factor provides one sense of a control for research in environments where laptop access is for both in and out-of-school use, since achievement gains appear without the link to full-time technology immersion, albeit to a lesser degree.

Mann, (1999) in a study of West Virginia's Basic Skills Program, found that when students had consistent access to computers and expressed positive attitudes toward technology (along with their teachers), they saw consistent gains on standardized exams with lower achieving students seeing the highest gains. His study of technology use by 950 fifth-graders from 18 elementary schools found computer use more cost effective for raising student achievement levels than class size reductions, increased teaching time, or mentoring programs utilizing older students.

Wenglinsky (1998) similarly identified advances in achievement on the standardized National Assessment of Educational Progress for eighth grade students who showed gains of 15 weeks above grade level after using simulation and higher order thinking software. Students in both grades 4 and 8 who used higher order software and whose teachers received professional development in technology saw increases of 13 weeks in a study which attempted to isolate the technology-to-student effect by controlling for socioeconomic status, class size, and teacher traits.

In the NAEP studies, fourth grade students using programs for mathematics learning games increased their achievement spread by three-to-five weeks over students who did not access technology, but both fourth and eighth graders who used drill and practice software emphasizing routine over critical thinking saw a drop in scores. Wenglinsky's research found that purposeful use of technology requiring engagement of students' critical thinking made a difference in whether technology helped or harmed student achievement.

Research provides evidence that students gain not only as persistent users of technology, but as developers as well (Rosas et al., 2003). Robertson & Good (2004) found increases in students' engagement with and success in narrative writing through the development of interactive video games. Noting that only recent advances in programming and animation allow students to create truly interactive games by designing in virtual worlds like Second Life, the researchers used the educational software, *Neverwinter Nights*, to help Scottish secondary students create 3D, role-playing computer games. During post-production interviews, participants reported being engaged in the storyboarding, writing, and production process; they also reported an appreciation of the sense of audience that came from creating a game that would be used by attendees at a city festival.

An analysis of their games revealed links to traditional English literature, complex dialogues, and highly involved settings. Similarly, the game structures revealed more characters than settings, and a reliance on interactive dialogue allowing player decisions to tell and direct the story. Robertston and Good noted that the students' games required them to develop an advanced component absent from traditional narrative: active background writing in which the author must guide the player through the game, but still allow choice and multiple routes to completion. The combination of engagement and complexity makes gamemaking a venture capable of increasing students' literacy skills, the researchers concluded. Robertson and Good (2004) explained:

> They became engrossed in the games design task, particularly when using the computers, and it was very difficult to persuade them to stop what they were doing and take lunch breaks. Some pupils were so keen to finish their games that they arrived early and stayed late after their afternoon sessions. This behavior is particularly striking because this was a voluntary activity during the summer holidays when they could have been doing any activity of their choice. (p. 57)

Robertson and Good's work built from seminal research by Papert (1993), the Massachusetts Institute of Technology professor whose research with children using the programming language Logo was originally designed to help students learn mathematics, particularly geometry. I discuss Papert's connection to the Maine 1:1 laptop program later in this chapter. Logo allows users to direct an object (typically a turtle) through a series of paths with obstacles to navigate around. Using programming and the tenets of artificial intelligence with children teaches that young learners need to experience a different mindset than the one instilled from the world of school, Papert stated. While errors traditionally are things to be avoided or erased in the work of school, in programming such faults become the moments of learning. "Errors benefit us because they lead us to study what happened, to understand what went wrong, and through understanding, to fix it" (p. 111).

Technology, used in authentic means with children as designers, also changes the student-teacher relationship from one of learner-to-master to learner-to-learner, Papert argued. He explained: "A very important feature of work with computers is that the teacher and the learner can be engaged in a real intellectual collaboration; together they can try to get the computer to do this or that and understand what it actually does" (p. 115). Rather than student as recipient of knowledge, again, a break from the "banking" model of education identified by Freire (1970), technology opens the potential for student and teacher as co-creators of learning experiences, with technology the mediating factor.

Prensky (2008), a steadfast supporter of children as creators of interactive media, suggests that teachers reveal an inability to see experiences through their students' eyes when they design learning experiences, rather than provide students the opportunity through technology to transform the curriculum into experiences that reflect the educational goals. He cites Lim (2008) in providing a reason why some pre-packaged games do little more than provide skill and drill exercises. Lim (2008) explained:

> If educators design learning experiences based solely on their own vision, goals, and circumstances, they may be merely imposing their set of values upon their students; engaged learning is unlikely to happen in such an environment. It is only when students are empowered to take charge of their own learning by co-designing their learning experiences with teachers and other students that they are

> more likely to be the designers of their own computer games based on their own interpretations of their school curriculum. (p. 101)

Research in a 1:1 Environment

Much of the recent research on the effects of technology integration has focused on the 1:1 environment, defined generally as the scenario where each child and teacher is provided access to a computer. An increasing number of districts are implementing 1:1 programs in which students are provided the ability to access a computer both at home or in school, an environment like that offered for middle and secondary students in Maine (Greaves & Hayes, 2009; U.S. Department of Education, 2010). As of 2010, a survey of U.S. school districts revealed that approximately 50 percent were either implementing or in the process of implementing a 1:1 computer program, though about half that number were creating programs that would allow students the opportunity to use their computers either at home or in school (Branch, Orey, & Jones, 2010).

Maine's statewide initiative for middle school students and their teachers was expanded in the fall of 2010 to allow districts the option to enlist all students and teachers in grades 7-12. Some districts, like Coveside, found that the infusion of technology allowed administrators to expand their existing technology program to provide widespread access to computers for students in lower grades.

Research on 1:1 educational technology began in the mid-1980s with the start of the longitudinal study of the Apple Classrooms of Tomorrow project (Dwyer, 1994). That study blended qualitative and quantitative approaches in seven classrooms where teachers and students were given full-time access to computers, duplicate equipment and software packages for both home and school use. The study, while different in many ways from my own work, is important because it not only sets the groundwork for much of the following educational technology research, but also establishes one of the first instances where computing was ubiquitous – available for students and teachers in school and at home. That early trend has only grown since then. Now students at Coveside, the middle school in my study, can even use their school-issued laptop computers on the bus ride to and from school.

The ACOT study, according to Dwyer, found some of the following trends when technology was injected into the classroom and personal lives of students and educators:

- Teaching became learner-centered and interactive, rather than teacher-directed, didactic instruction;
- The role of the teacher morphed to one of collaborator and sometime-learner, and the role of students developed into one of collaborator and sometime-expert;
- Knowledge was seen as something to be transformed, rather than just accumulated;
- Assessment became seen through portfolios emphasizing quality over quantity.

The findings echo those of Papert's work with Logo programming, in particular his description of the resulting change in the role of teacher with the introduction of technology into the classroom. Overall, Dwyer (1994) reported that the work of school became focused on communicating, collaborating, accessing information, and expressing learning in creative approaches. One teacher-participant in the ACOT study reported changes in the dynamics between children, their relationships with each other, and the role of their teachers. Dwyer (1994) explained:

> Children interacted with one another more frequently while working at computers. And the interactions were different – students spontaneously helped each other. They were curious about what the others were doing. They were excited about their own activities, and they were intently engaged. These behaviors were juxtaposed against a backdrop in which the adults in the environment variously encouraged and discouraged alternative patterns of operating. It was as if they were not really sure whether to promote or inhibit new behaviors. (p. 6)

Researchers reported students with higher levels of engagement, reduced absenteeism, earlier completion of units of study, and writing that revealed a higher level of fluidity and effectiveness at communicating ideas. In one study location where computers were used with the expressed purpose of helping raise student test scores, Dwyer (1994) reported students obtaining higher scores on the California Achievement Test in "vocabulary, reading comprehension, language mechanics, math computation, and math concept/application" (p. 5-6). Where computers were not directed for such purposeful test achievement applications, students performed at least as well as non-computer using students on standardized test scores, according the results.

The transformation from didactic to constructivist learning environments where collaboration and exploration were dominant factors was not as fluid in classes where instruction and achievement depended on the teacher as central. But, Dwyer noted, the infusion of technology prompted teachers to shift their traditional roles. "We watched technology profoundly disturb the inertia of traditional classrooms" (p. 8). Researchers in the ACOT study found the greatest increases in overall student achievement came in those classrooms where teachers started to find a balance between direct instruction and collaborative, inquiry-driven learning. As Dwyer (1994) explained:

> In those classes, interaction among students was ordinary and purposeful; children were seen as learners and as expert resources; and students were challenged by problems that were complex and open-ended. In assessing students' work, teachers looked for evidence of deeper understanding – statements of relationships, synthesis and generalization of ideas to new domains. And, of course, students had opportunities to use a variety of tools to acquire, explore, and express ideas. (p. 9)

Integration Studies Beyond ACOT

After the initiative funded partially by Apple Computers was under way, Microsoft Corp. and Toshiba developed a laptop immersion program in 52 schools in the United States starting in 1996, moving up to 800 schools and 125,000 students and teachers by 2000. Similar to the ACOT model, students and educators in the *Anytime Anywhere Learning Project* were provided with round-the-clock access to technology; an increasing number of students through the study were also equipped with access to the Internet. The project was studied through both quantitative and qualitative means – survey of test results, student grades, and various measures, as well as observation, interview, and focus group. Participating teachers were also provided with professional development in using technology to help students meet curricular objectives. Reported by Gulek and Demirtas (2005), research of the *Anytime Anywhere Learning Project* conducted by Rockman et al. (1997, 1998, 2000) found students:

- Taking roles as more active learners directing their own learning;
- Spending more time in collaborative projects;
- Producing more writing and writing at a higher level of quality;
- Participating in more project-based education;
- Engaging in critical thinking and problem solving.

Mirroring some of the achievements by their students, teachers taking part in the program exhibited a more constructivist approach to teaching, lectured less, and reported feeling more empowered in their classrooms (Gulek & Demirtas, 2005).

While the *Anytime Anywhere Learning Project* showed gains in a number of areas, results did not indicate an improvement or decline in standardized test scores for laptop students (Warshauer, 2006). That flat testing scenario may be due in part to the ways computers were used in schools. Warshauer (2006), whose work I will discuss in the following section, suggests that skills and new literacies valued in the 21st century are often not measured in traditional mass-instituted tests. Warshauer (2006) explained:

> There is certainly little on standardized tests to assess students' ability to rapidly find, critique, analyze, and deploy new information, nor are there items that test students' ability to interpret or produce multimedia, including images, sounds, video, animation, and texts. Even writing, which should be the measurable skill most amenable to improvements through laptop programs, is problematic to assess, since the paper-and-pencil assessment of standardized tests are known to substantially underestimate the writing ability of students who have learned to write on computers. (p. 33)

Warshauer points out one of the more commonplace criticisms about education technology, that its results do not figure in testing situations. Later in this section, I discuss other research in Maine (Silvernail & Gritter, 2009), which provides support that technology does help improve writing, even when measured in a standardized testing scenario.

New Literacies

Warshauer, (2006) along with other researchers (Coiro, Knobel, Lankshear, & Leu, 2008), refer to the "new literacies" students will need to master as part of the collective skills commonly deemed necessary for success in the current age. Those literacies include the necessity of navigating – both as consumer and creator – blogs, wikis, social networks like Facebook, e-books, websites and online or electronic documents, music and media dissemination sites such as YouTube or Tumblr, threaded conversations and comments, and even massively multiplayer online games such as *World of Warcraft* or *Happy Farm*. Coiro et al. (2008) explain:

> Literacy is no longer a static construct from the standpoint of its defining technology for the past 500 years; it has now come to mean a rapid and continuous process of change in the ways in which we read, write, view, listen, compose, and communicate information. (p. 23)

Because of the rapidly changing way that information is shared and interacted with today, part of the idea of so-called "new" or 21st century literacy involves understanding not just the myriad developing ways to come of understanding information, but understanding when and how to adapt existing literacies and deciphering skills to meet demands of resources not yet identified.

What exactly are the “new” literacies? Coiro et al. (2008) cite Lessig (2005) as suggesting that new literacies may not be specific, identifiable modes of text, but the way in which digital components, “building blocks that young people use for encoding meaning” (p. 26) such as digital animation, audio and video clips, and images – both appropriated and self-created – are put together in new ways for different purposes. Gee (2010) distinguishes new literacies as those occurring within communities that are part of the trend of “pro-ams” (p. 174) where amateurs grow into professionals as they hone their communication skills through the use of digital tools that are “changing the balance of production and consumption in media” (p. 174). These “pro-am” users add and connect media – at times even unaware they are building these connections – with other consumer-participants to build deeper, more complex meanings that can range from collaborations using shared media, remixes with media not intended to be shared, or simply heightening the meaning of one statement by the addition of a clarifying or explanatory comment on a blog post.

The study of new literacies creates an emphasis “not just on how people respond to media messages, but also on how they engage proactively in a media world where production, participation, social group formation, and high levels of nonprofessional expertise are prevalent” (p. 175). Gee echoes the sense of “participatory culture” (Jenkins et al., 2007) that I refer to in the previous chapter, and again later in this chapter, as one component of what distinguishes those classrooms where students are able to connect to the outside world and take part, versus those where students are held culturally captive.

Developments in the 1:1 Environment

Following the early success of the ACOT and *Anytime Anywhere Learning* initiatives, one of the first districts in the U.S. to implement a large-scale 1:1 laptop program was that of Henrico County, Virginia, which distributed laptops to staff and students of its high schools in 2001. The district became the largest single entity to create a 1:1 environment when it expanded its program – first with Apple computers and subsequently Dell when a contract was changed – to all of its 25,000 secondary and middle school teachers and students (McGhee & Zucker, 2005). The Henrico program from its start enabled students to bring their computers home and offered families a reduced rate for Internet connection. Parents also received training in both use of the computers and the Internet, and some reported that the additional machine in their home enabled families with multiple children to have several using technology at the same time; other families reported that parents who had not been capable of utilizing technology subsequently gained those skills (McGhee & Zucker, 2005).

A study by SRI International and Education Development Center, Inc. (2005), echoed the results of the ACOT and Microsoft initiatives: students reported themselves better organized, more motivated, engaged, and self-directed, and better equipped to access information. The district provided students with access to a variety of learning resources for use through the laptops, including SAT tutorial software, access to licensed websites including video streaming and e-book services, as well as learning management systems that provided access to teacher-created AP course resources (McGhee & Zucker, 2005). As in other studies, the Henrico initiative showed students accessing non-traditional teachers for information, rather than relying on their classroom teachers as the source of their instruction, a situation paralleled in research by Ito et al. (2008) which showed that adolescents routinely use technology to build relationships with mentors and coaches outside the classroom, developing ways of working with digital media that relies on a collective, ad hoc system of out-of-school teaching and learning.

Teachers, parents, and students found some barriers to taking part in the 1:1 program. As mentioned, some educators found themselves with a need to plan for contingencies in case of missing, broken, or confiscated computers, and others faced behavior and classroom management problems. Ito et al. (2008) explained:

> According to one middle school teacher, ‘You can’t assume students have access to the Internet [at home] to do homework using the iBook.’ Along these lines, another teacher had ‘stopped giving homework on the iBooks because I was seldom getting it back.’ A third middle school teacher – an enthusiastic supporter of using iBooks for teaching and learning – noted inappropriate uses of the computer often occurred at home, adding: ‘Ideally I would like the students to take the iBooks home. But what I have seen is that when they do take it home, they do not know how to use it properly. They create all kinds of things [they shouldn’t], [and] download pictures and music. If we had classroom sets [that stayed at school], they wouldn’t have the same access to the materials . . . It is a tough choice; there is a trade-off.’ (pp. 24-25)

Some parents told researchers that they envisioned their children’s loads would be lightened and that heavy textbooks and binders weighting their children’s backpacks would be replaced by the computers, but found that transition was not taking place. While some students said they appreciated the chance to encompass more tools within one device – seeing the computer as calculator, writing instrument, note-taker, and connection to knowledge sources, others complained about what they saw as over-reactive teachers criticizing nonacademic uses of the machine or occasional off-task behavior. Some of the administrators surveyed in the Henrico study said they knew students would achieve at higher levels because of the increased work that could be done – enabling students to do more at a higher level of quality (McGhee & Zucker, 2005).

My study uses a model similar to the Henrico study's triad of perspectives - those of parents, students, administrators – to look at the sphere of influences acting on teachers at Coveside. While I discuss my approach more thoroughly in the following chapter, since the focus of my research centers on teacher perceptions, I examined this triad through the viewpoint of participating educators and their words and observations. There is ample precedent for the idea that teachers' perceptions can be influenced by outside forces, thus translating into success or the lack thereof inside the classroom. Pressley, Mohan, Raphael, and Fingeret (2007) found in a study of elementary reading programs that teachers were influenced by colleagues, administrators, parents, and students as a "community of inter-acting players" (p. 229) to support success in early literacy achievement.

The Maine 1:1 Laptop Program

In his study of 1:1 laptop programs in Maine and Hawaii, Warshauer (2006) built on Freire and Macedo's (1987) concept of portraying literacy as students' engagement with the word in the context of the world to contribute to and transform society. Students with widespread access to technology are equipped with a tool that allows them to rebel against Freire's characterization of teacher instruction as rote drill and lecture, knowledge as if it were money to be deposited in a bank. Warshauer (2006) explained:

> Students can discover authentic reading material on almost any topic, and be introduced to up-to-date information and perspectives from peoples and cultures across the globe. They can gather the information and resources to address diverse social issues, from how to maintain diverse ecologies to weighing the benefits and disadvantages of technological progress, to understanding why and how societies go to war. Students can then develop and publish high-quality products that can be shared with interlocutors or the public, whether in their community or internationally. And through these products, from reviews published for Amazon.com to Spanish-language books created for children in need, students can not only learn about the world, but they can also leave their mark on it. (p. 154)

Papert (1993) offered a glimpse earlier than Warshauer of computing in a 1:1 environment as a tool to transform school learning. Too often, he argued, educational learning characterizes the "chief differences between learning at school and all other learning . . . Generally in life, knowledge is acquired to be used. But school learning more often fits Freire's apt metaphor. Knowledge is treated like money, to be put away in a bank for the future" (p. 51).

Designers of Maine's 1:1 laptop program, the Maine Learning Technology Initiative, had Papert's philosophy in mind when unveiling the program in 2001. They explained:

> Our schools are challenged to prepare young people to navigate and prosper in this world, with technology as an ally rather than an obstacle. The challenge is familiar, but the imperative is new: we must prepare young people to thrive in a world that doesn't exist yet, to grapple with problems and construct new knowledge which is barely visible to us today. It is no longer adequate to prepare some of our young people to high levels of learning and technological literacy; we must prepare all for the demands of a world in which workers and citizens will be required to use and create knowledge, and embrace technology as a powerful tool to do so. (p. i)

Warshauer's research (2006) of Maine's 1:1 laptop program found increases in student reading achievement, knowledge-building and reading connection strategies, improvements in student success with the writing process, ability to conduct research, an ability to develop media and design concepts, and improvements in overall student achievement and engagement, what he termed "learning to be" (p. 126).

Research into the effects on student learning as a result of the MLTI program have included assessment (Beaudry, 2004), achievement in science (Berry & Wintle, 2009), overall student achievement (Silvernail, 2005), and writing achievement and self-efficacy (Warshauer, 2007; Silvernail & Gritter, 2007). In addition, a limited study found that given a specific intervention, students gained skills in evaluating information found on the Internet (Pinkham, Wintle, & Silvernail, 2008).

In Berry and Wintle's research into the impact of the laptop program on student science achievement, knowledge of key science concepts relating to the rotation of the earth around its axis were assessed prior to a specific teaching intervention. Using information from direct instruction approaches, as well as educational websites, some that featured virtual animations, students created an animation of their own, blending images and podcast to explain the scientific concepts. They were tested again on their knowledge of the concepts after completing the project, and then again after a month to test for long-term recall. During the teaching intervention, classes were observed for on-and-off task behaviors including handling resources unrelated to the assignment, students putting their heads on their desks, talking about unrelated topics, or leaving a seat for issues unrelated to the work. Observations showed most students engaged, and the post-class interviews indicated that students enjoyed the hands-on work of creating an animation and felt the approach gave them a better understanding of the concepts (Berry & Wintle, 2009).

Warshauer and his team noted the greatest impact on instruction in Maine's laptop program came in writing. Researchers found a “major effect on instruction at each stage of the writing process” (p. 76) and identified differences in the teaching of writing in a laptop vs. non-laptop classroom: “Writing became more integrated into instruction; more iterative; more public, visible, and collaborative; more purposeful and authentic; and more diverse in genre. Students’ written products improved in quality, and student writing became more autonomous” (p. 76).

One of the more notable aspects recognized in the 2006 study was the different types of writing enabled by technology. Beyond traditional narrative, expository, or other compositions, students were able to write in a variety of genres and layouts, including pamphlets, newspapers, video, advertisements, and other genres. Warshauer, as have other researchers, (Gee, 2008; Isiksal & Askar, 2005; Robertson & Good, 2005) reported that such writing, let alone the potential to publish and share it with audiences, would be severely restricted without technology.

Noting that students seemed to most benefit from using their laptops for writing, Warshauer is also careful to point out that as of 2004, roughly two years after the start of the Maine 1:1 program, laptop use had not translated into a rise in writing test scores. But he pointed out that writing with technology represents a new form of writing that is not reflected by standardized writing tests that may either test students' knowledge of writing mechanics, or may test them based on timed, pen-and-paper scenarios. Authentic writing in today's world is dramatically different, he stated. Warshauer (2006) explained:

> It is virtually always done by computer, taking advantage of a variety of computer-based tools, and in many cases, drawing on information from the Internet. It is usually done over time, with writers thinking about their message and continually revising their text. It is also done collaboratively, either through co-authorship or by responding to feedback and suggestions from others. The laptop classes we witnessed without doubt helped better prepare students for these real-world writing tasks. (p. 83)

Silvernail and Gritter (2007) found five years after the institution of Maine's laptop program that student writing scores increased across the state on the eighth grade Maine Education Assessment, the statewide standardized exam. The researchers found a significant improvement in test scores, ($t=31.51$, $df=32806$; $p<.001$) a climb from an average score of 534.11 to 537.55 with a test population of about 16,500 students. But the researchers found no statistical difference in the jump in scores between students who wrote for the test with computer versus those who used the traditional pencil and paper.

However, Silvernail and Gritter's analysis did reveal a difference in scores among students based on the extent to which their laptops were used in writing instruction. Scores were lowest for students who reported no or little computer use in school while the students reporting the highest level of use correspondingly saw the highest gain in scores. Silvernail and Gritter found that the greater the use of computers for drafting, writing, and editing, the higher the corresponding gain in scores.

Perceptions in Teacher Action

Teachers have a great deal to do with the success or failure of the implementation of technology in the classroom, particularly with the demands imposed by the immersive environment created in a 1:1 computing program (Glass and Vrasidas, 2008; Lim & Hang, 2003; Russell, Bebell, & Higgins, 2004; Warshauer, 2004, 2006; Warschauer, Grant, Del Real, & Rousseau 2004; Windschitl & Sahl, 2002; Yamagata-Lynch, 2007; Zhao & Frank, 2003).

Teacher perception, as well as skill in the classroom, is an important factor in the success of the implementation of instructional technology. In Maine, a study of special education teachers' perceptions of the laptop program's effectiveness indicated that teachers saw the technology as contributing to improved behavior, heightened motivation, engagement, independence and the ability to retain material for their students (Harris & Smith, 2004). Teachers also said they believed the 1:1 program helped increase student participation, and offered the opportunity to create more positive student-to-student and student-to-teacher interactions (Harris & Smith, 2004). While perception of effectiveness is important, other researchers have found that limitations in technology skill can hamper integration efforts. In an activity theory analysis, Blinn and Munro (2008) found that educators who lacked training in using online tools were unlikely to attempt implementing computers in their instruction. Likewise, educators who had opportunity to engage in training, interact with colleagues, and experiment in a supportive setting were more likely to employ technology tools in their classrooms (Zhao & Frank, 2003).

Personal Views

Another Maine study has used survey data to link teacher philosophy regarding computers to technology integration, connecting responses on a statewide survey providing personal views favorable towards technology to higher levels of computer use by the respondents' students (Gritter, 2005). But, the study found, math and science teachers prove an exception to that result. Gritter suggested that districts may need to consider mandating computer use to ensure all students gain exposure to 21st century learning opportunities. That question may prompt future investigations about the effectiveness of mandated computer integration. As Gritter (2005) explains:

> The best predictor of computer use is prior computer experience. This may suggest a need for additional pre-service computer training and on-going professional development if computers are going to be used extensively in all classrooms. It may simply be that the more comfortable and knowledgeable a teacher is with computers the more likely they are to use a computer themselves and to utilize the laptops in their instruction. (p. 8)

Professional Development Needs

In the Henrico County study, McGhee & Zucker (2005) found a number of issues relating to the fluidity of the program's implementation and overall integration as an essential learning tool that were impacted by teachers, including the real and perceived challenges of managing a laptop classroom with potentially distracting or off-task student behaviors, the need for additional planning time to better use the computers, and the necessity of developing alternate instructional approaches for those students who have either damaged or confiscated machines. But, McGhee and Zucker reported, "it is significant that nearly all teachers interviewed for the study believed that the benefits . . . outweighed difficulties associated with time and classroom management, lesson planning, and learning to use the laptops" (p. 20).

Researchers in the Henrico County study noted that the level of participation in professional development varied for educators from stipended full-day and multi-week courses to, at one school, only 10 hours of professional development. But the researchers found that "most of the teachers in the case study sites engaged in a great deal of informal professional development" (McGhee & Zucker, 2005, p. 23). In Henrico County schools took on the role of professional development providers as well as participants. McGhee and Zucker (2005) explained:

> From our interviews with teachers, school administrators, and division-level staff, it became evident that expertise in technology was not regarded only as the domain of people with certain job titles in the school system; teachers themselves were often leaders in professional development. (p. 23)

That scenario, a similar approach to one advocated by the National Writing

Project's philosophy of teachers as effective agents of professional development (National Writing Project, 2010) is shared at Coveside Middle School where teachers take part as participants and occasionally as presenters in summer technology institutes and quarterly professional development programs.

Based on his research, Warshauer calls professional development an essential component in any 1:1 initiative. "The implementation of laptop programs, as with other uses of technology, is highly shaped by teachers' attitudes (see in particular Windschitl & Sahl, 2002), and professional development is thus critical for successful implementation, as is sufficient technical support" (p. 33).

Communities of Practice

Glass and Vrasidas, (2008) consider this model one that helps develop "communities of practice" (p. 90) where teachers bound by common activity collaboratively mentor each other, either formally or informally through conversation and problem solving. Based on their research with teachers in Cyprus, they found professional development, particularly through collaborative partnerships formed with educators who effectively used technology as an instructional tool, a necessity to offset what they saw as a dearth of high-quality integration in schools. As Glass and Vrasidas (2008) explain:

> Effective professional development is situated in teachers' everyday practice, and distributed across communities, tools, and contexts. As such, it provides authentic opportunities for teachers to think like experts in making instructional decisions, structuring learning activities, and employing sound pedagogical practices. (p. 94)

Glass and Vrasidas used the framework of cultural historical activity theory (Engeström, 1987, 2001) in their research in which university-level researchers established partnerships with local teachers and schools to develop curricula integrating technology approaches in unit design blending environmental studies with multiculturalism and peace studies. Those units became the focal point for professional development and the resulting communities of practice. My own research at Coveside builds on the work of Glass and Vrasidas and a growing number of researchers who view technology integration among classroom teachers and school systems through the lens of activity theory. I discuss activity theory in relation to technology integration in more detail later in this section, and in the following chapter, I provide my rationale for the selection of this analytical framework.

Teacher Beliefs

In their study of 1:1 computing environments, Windschitl and Sahl (2002) found that the existence of pervasive technology was not enough to direct teachers to change toward a more constructivist, learner-centered approach. They found that "norms and expectations for technology use were generated through a number of activities within the school community but were reinterpreted by individuals through participation in a variety of settings, some of them outside the school" (p. 202). Environment also played a role and the impact of such settings "appeared to be dramatically shaped by teachers' situated beliefs about learners and legitimate learning activities in the classroom" (p. 202) as well as the impact of others, both within and outside of the teaching-team community.

Myhre (1998) also found that teacher beliefs about teaching and learning influenced the integration of technology, describing in a case study a mathematics teacher's use of technology to reinforce pre-existing beliefs, rather than prompt a change in educational approach. Other researchers, including Levin and Wadmany (2008) found in a three-year longitudinal study that dialogue with technology-using colleagues, a loose peer-coaching model, shaped educator beliefs about the advantages of teaching with technology and led to a greater incorporation by non-integrators. Friedman and Kajder (2006) reported that pre-service teachers experienced a shift in perception when given a variety of experiences in technology integration; their subjects disclosed greater confidence and an increased likelihood that they would "question, challenge, and select appropriate technologies for classroom use" (p. 150).

Administrative Influences in Technology Integration

There are several precedents for my own study's focus on the potential influences from administrators, both via policy/document analysis and through questioning of participants. In the Henrico County study, (McGee & Zucker, 2005) one technology coordinator told researchers that it was difficult to get some teachers to break from existing routines and use the laptops, estimating that approximately 20 percent of educators in the district actively resisted using technology. Successful schools saw influences from administrators as one key for success. That trait is echoed in research from Chang, Chin, & Hsu (2008) who found positive links between administrators' views and use of technology and the level of integration by teachers. Other researchers also found that administration-led integration, done in a supportive, influential rather than authoritative model, proved effective at increasing technology integration at the K-12 and university levels (Strudler & Wetzel, 1999).

Chang, Chin, and Hsu (2008) disclosed that elementary school principals who embraced technology and supported its use were perceived by their teachers as partially responsible for increasing the technology integration level in their buildings. The study's statistical analyses at schools in both U.S. and Taiwanese schools found a strong correlation between principals' technology leadership and an effective use of technology in the classroom. That connection, combined with the provision of financial support for equipment and access, also suggested that teachers who perceive support from their administrators for technology use are more likely to incorporate technology in their classroom.

Influences Inside and Outside Classrooms

My study takes a different tack than much of the previous work in Maine by examining how the perceptions of middle school teachers are influenced by this combination of external and internal pressures around integration of technology in the classroom, and ultimately how those perceptions drive, or impede integration, potentially offering learners broad involvement in a participatory culture, or restricting access to out-of-school experiences only available to those able to support their involvement on their own (Jenkins et al., 2007). Perceptions are just one of a number of factors that drive the climate of the school experience, as well as the potential for reform and the implementation of change. Cambre and Hawkes (2004) suggest that a number of elements inherent in the school system ultimately affect the ability of the inhabitants, the students, to achieve favorable outcomes. “These elements include administrative innovations, curricular adjustment, program and classroom organization, the nature of teachers’ instructional approaches, the ways time and space are used, school – community partnerships, and logistical and social factors” (p. 42).

The experience of teachers and their success at integrating technology are influenced through conversations, observations, and shared experiences with colleagues, as well as participation in out-of-school dialogues and experiences (Blin & Munro, 2007; Lim & Hang, 2003; Zhao & Frank, 2003). Student and parental expectations also influence teacher technology use (Warschauer, Grant, Del Real, & Rousseau, 2004; Windschitl & Sahl, 2002). In their study of 1:1 computing environments, Windschitl and Sahl (2002) found that the existence of pervasive technology was not enough to direct teachers to change toward a more constructivist, learner-centered approach. They found that “norms and expectations for technology use were generated through a number of activities within the school community but were reinterpreted by individuals through participation in a variety of settings, some of them outside the school” (p. 202). In short, research shows that placing computers in the hands of teachers and students does not lead to their automatic integration in teaching and learning, but rather, a number of sources have a role in whether, and how they are ultimately used.

Activity Theory and Technology Integration

It is the recognition that a range of internal and external factors ultimately influences the outcome of schools – an educated student - that makes cultural historical activity theory an ideal lens through which to view the way in which technological change does or does not happen within the education institution, and specifically, within the classroom (Engeström, 1987, 1999, 2001; Lim & Hang, 2003; Yamagata-Lynch, 2007, 2010). A review of the research provides an overview of ways in which activity theory has been used in the study of educational technology integration to date.

Teachers, school, and education in general comprise a system defined by activity with an end product: educated individuals, or individuals with an education and ability to advance their own education. The teachers who are the focus of my research comprise a system through the shared students, physical environment, and curriculum, creating a dynamic environment in which students enter, strive to achieve particular objectives through the undertaking of a variety of activities, and then exit to graduation and advancement to high school (Hoy & Miskel, 2005). Yet, these teachers remain subject to a variety of internal and external factors, from student skill level and learning ability, to state, administrative, community, and parent demands, both implied and explicit. Cultural historical activity theory has a record in the research literature as a framework for examining multiple, potentially conflicting, sources of influence, in the case of my study, the impact of forces influencing teachers' perceptions on the decision of whether or not to employ technology in classroom instruction and opportunities for student learning (Blin & Munro, 2007; Engeström, 1987, 1999, 2001; Lim & Hang, 2003; Romeo & Walker, 2002; Yamagata-Lynch, 2007).

Activity Theory Background

Since arising from Soviet Union social psychology and undergoing a variety of enhancements in the late 1980s and early 1990s, variations and developments of cultural-historical activity theory (Arievitch, 2007; Engeström, 1987, 1999, 2001) have offered a framework for research into the role of technology in education and its impact on learning, the ultimate outcome of the institution of school. But most studies to date have not offered a refined insight into the ways in which teachers perceive a mix of influences both from within and outside the sphere in which they operate, particularly within a framework driven by an established 1:1 laptop environment, also referred to as a "ubiquitous computing environment."

Researchers have employed cultural-historical activity theory to examine issues around technology integration based on the idea that schools operate as open systems (Banathy, 1992; Hoy & Miskel, 2005) subject to both internal and external influences (Engeström, 1987, 1999, 2001). Dellar (1994) describes the school organization as one with education, the central activity, occurring within an inner space that is subject to the influences of factors such as policy and economics helping to make up a socio-political context, as well as interrelations between staff, community, and resource availability. Figure 1 presents a socio-political view of the environment in which schools operate, and the overall context for a study such as this one.

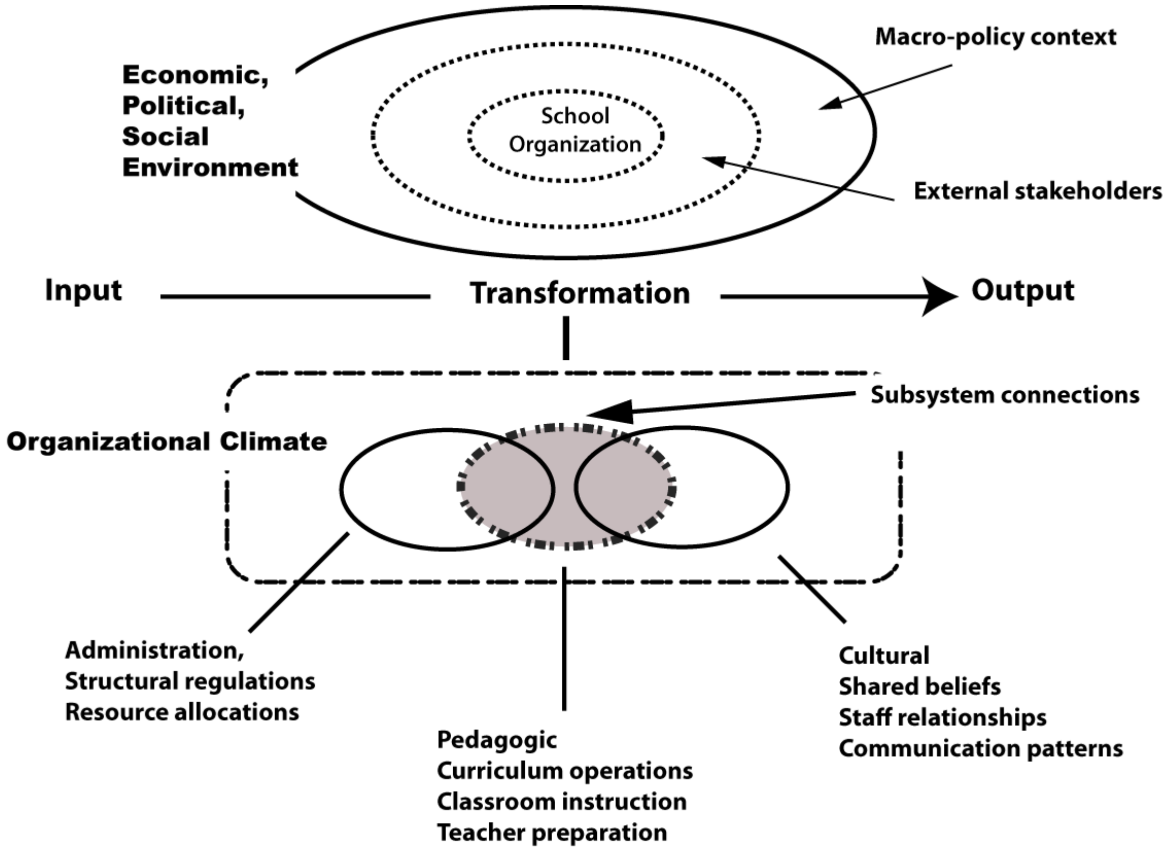

Figure 1. Expanded open system model. The school organization sits within a permeable atmosphere subject to influences from a variety of external sources impacting internal systems such as policy, resources, professional climate, and instruction. Source: Dellar (1994), Banathy, (1992). Modified by Boardman, 2012.

Dellar (1994) and Banathy (1992) designate the school organization as one with a permeable border through which influences can flow from external stakeholders, either directly or through policy directives, or economic, social, and political factors. Organizationally, visible in the bottom half of Figure 1, the actual “teaching” occurs in a zone influenced by factors from resource availability to influences from fellow staff members, the sense of camaraderie and professionalism or isolation and insularity, for example. As a precursor to viewing school organizations through cultural-historical activity theory, my model based on previous versions by Dellar and Banathy offers one view of the permeability of the zone of teaching, an abstract space peppered with external and internal forces where an input, the student, is transformed, ideally, into the hoped for outcome, the educated individual able to perpetuate his or her own learning. That forms the conceptual basis for my use of activity theory in this study.

Activity Theory in Study Context

Building on the theory of education organizations as open systems, my inquiry works in the realm of the third-generation of cultural-historical activity theory where activity is examined not in isolation but within an atmosphere of activity systems. A subject - teachers' perceptions - is likely to receive influences from actions coming from within its own environment, as well as from outside activity systems.

Activity theory, a successive build of work by Vygotsky, Leont’ev, and Engeström (Roth & Lee, 2007), examines change in a subject – or the subject’s process of resisting change, through a triad of influences as that subject faces a transformation, ultimately reaching the objective, or holding fast unchanged. Those influences that make up the “triangle” used to evaluate the change on a subject include tools (machines, words, writing, and other mediating influences) at the apex, rules of the community in which the activity is located, the community itself, and the division of labor, or roles and responsibilities of participants.

Initial generations of activity theory offered a description of activity as the transformation of a subject into the end result, the object, via the use of various mediating implements – tools, writing, speech, architecture and others. Engeström added the additional influences of societal rules, community norms and influences, and jobs and the roles inherent in a division of labor (1987). His evolution of activity theory (1999) brought it to its current third generation (see Figure 2) in which he suggested that activity needed to be examined not as an individual outcome, but rather as the interaction of multiple units of activity occurring within a social world, developing an outcome that shares characteristics or becomes a composite with outcomes from other, related activity systems. As my research occurs within a school environment where nearly all activity is somehow dependent upon or related to other activity elsewhere, the development of a theory that recognizes these connections on multiple levels toward a common, shared outcome is a natural fit.

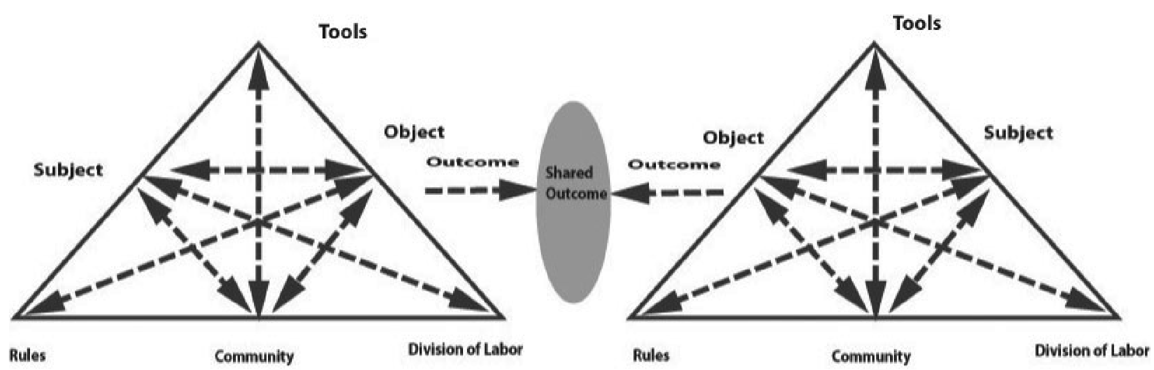

Figure 2. Third generation model. Engeström’s third generation of cultural-historical activity theory (1999) points to a shared outcome, partially or in whole, from the connections developed between multiple activity triangle networks.

In Chapter 3, I expand on Engeström's model to show an activity system in an environment where activity systems act on activity systems; I base that expansion on the basic concepts of open systems and the perspectives already discussed of Dellar (1994), Banathy (1992), Zhao & Frank (2003), and Engeström (1999). The framework provides an opportunity to view educators as key players within cultural-historical activity systems where a collection of forces act upon their perception of influences from stakeholders regarding the integration of technology in the service of literacy instruction. Other researchers have supported a similar framework that takes a holistic approach to studying perceptions around technology integration. Lim (2002), adapting an ecological model from Cole (1995), suggested that technology use be examined as the center of a concentric ring of circles, each with a broader scope of influence over the central classroom, student, or educator interaction with technology. While the ecological model put forward by Lim reflects the weight of outside influences on an educator considering the integration of technology, it does not do so in a way that reflects the transformation of a subject to outcome of activity that is a hallmark of activity theory.

Researchers have used activity theory to examine instructional technology as a mediating tool providing equity and access in educational settings (Daniels, 2004; Murphy & Manzanares, 2008; Sheehy & Ferguson, 2008), as a tool for examining participatory, collaborative, and constructivist reform (Chang, Chin, & Hsu, 2008; Lim & Hang, 2003; Tam, 2008; Reeves & Forde, 2004; Romeo & Walker, 2002), and as an aid in understanding human-computer interaction (Mwanza, 2002; Nardi, 1996).

In a meta-analysis of research, Yamagata-Lynch (2010) recommended cultural-historical activity theory as a framework especially useful to qualitative researchers examining systems undergoing or resisting change within a social context. Activity theory is not so directed at whether or not change occurs, but on the forces that either prompt or prevent that change from occurring. The theory's value, Yamagata-Lynch argued, is that it can provide researchers a perspective that other analytical frameworks may miss because it "can identify findings that encapsulate the entirety of the observed data and can avoid isolating it from the real-world context to which it was observed" (p. 30). I discuss activity theory in more detail in Chapter 3.

Conclusion

My review of the literature reveals an extensive body of work on the integration of technology and the multiple forces acting on teachers' perceptions that either drive or impede the integration of technology. But that same review yields limits that my research aims to help offset. My inquiry attempts to widen the breadth of the overall body of research by examining multiple influences as perceived by middle school educators who work in an environment with a lengthy history in providing 1:1 computing. I undertake a close analysis of the voices of teachers, listening to their perceptions of support or disapproval for technology usage and charting an analysis of how certain influences can drive integration, impede it from occurring, offer views of new approaches to using technology, or even pose contradictions that raise further questions about technology and education.

CHAPTER 3: METHODOLOGY

This study seeks to discover how educators' decisions to integrate technology are shaped by an array of forces, some as obvious as the availability of computers, and others as subtle as a remark from a colleague, student, or principal. Finding an answer to that query meant seeking out and listening to the voices of participants, observing their classroom practice, and examining third-party sources to gain a look at the influences and contradictions behind these decisions. As I noted in Chapter 2, when I designed this study it became obvious that a potential analytical framework might lie in cultural historical activity theory since those forces could be examined within the societal context of the decision-making process. As the design of this study progressed, it became apparent that cultural historical activity theory would also prove the ideal framework for shaping data collection, since it positions the participants, their perceptions, and the resulting decision within a schematic map that encompasses the full potential range of forces. This chapter offers insights both into the design of my study from a conceptual point, as well as methodological, in preparation for an explanation of the data collected within the framework and my resulting analysis in Chapter 4.

Conceptual and Methodological Frameworks

This ethnographic study borrows directly from systems theory (Banathy, 1992), viewing the participants as part of an open system, not acting with full autonomy but subject to administrative directives and influences both from within and outside the bounds of their teaching environment and overall school. As individuals, they operate as sub- or nested sets of the open system that exists in the context of their middle school as a whole (Hoy & Miskel, 2005).

In many ways, this study runs in a parallel fashion to a case study, since the participants form a bounded case sharing teaching space, curriculum, and collaborative efforts toward a common outcome, the education of part of a school population totaling nearly 600 students (Banathy, 1992; Hoy & Miskel, 2005). This research extends beyond a case study, however. Only part of my interest lies in the interactions of the participants within the culture formed through the connections with technology resources available, teaching partners, students, and other stakeholders. I am also interested in the external, bureaucratically directed culture formed through policy and funding directives from local and state policy creators and implementers (Merriam, 2006).

Because the individuals' operating spheres were subject to both interior and exterior influences, an analytical approach that allowed me to represent each participant, both as an individual teaching unit and in concert with the school community, made the most sense. Of several approaches I explored, cultural historical activity theory and its use of analytical activity triangles best allowed me to examine forces at work on the participants' perceptions of influences affecting their decision of whether or not to implement technology into the instructional practices and learning experiences within the classroom (Engeström, 1987, 1999, 2001; Murphy & Manzanares, 2008, Yamagata-Lynch, 2010).

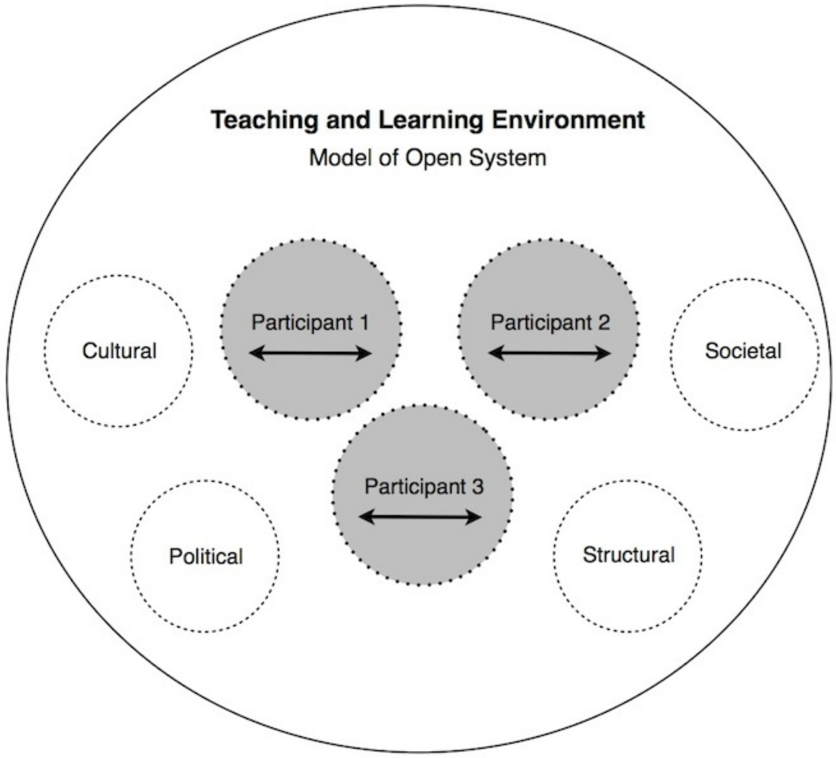

Figure 3. Open system model. Hoy & Miskel's (2005) model of school systems, adapted by Boardman (2011) describes a school system where the three study participants and their teaching environments, denoted by permeable boundaries, are influenced by cultural, societal/individual, political, and structural/technological factors. In turn, though not a focus of this study, the three participants have a symbiotic relationship with the learning system made up of the school as a whole. This concept of an open system forms the rationale for use of cultural historical theory as an analytical basis for this study.

Figure 3 represents a graphical framework for my research analysis, building on the Expanded Open Systems Model presented in Chapter 2, and leading to the third generation model of expanded learning activity systems by Engeström (1987). The model I present illustrates the sphere of activity within a framework that represents activity influences from both the participant's immediate environment and the larger community, designated by Hoy and Miskel as the Teaching and Learning Environment, and made up of influences from cultural, societal, political (including financial), and structural, from curricular to technological. This model provides the basis for the more developed Multiple System Model modified from Engström's design which provides a global view of the participants within the analytical framework (Figure 4).

As I entered this study, I anticipated that the data gathered might be most appropriately interpreted through the lens of cultural historical activity theory, which, following research trends I refer to synonymously as activity theory, (Engeström, 1987, 1999, 2001). But it was only on listening to the voices of my participants, reviewing extensive notes from classroom observations, and coding the data gathered that I realized activity theory would indeed best offer a framework to analyze the results of my inquiry since it provides the opportunity to account for influences from both within and outside of the immediate locus of operations of each of the participants. While I had considered other analytical lenses, including grounded theory and ecological theory, as analytical vantage points, activity theory provided a view which framed the research question within a broad spectrum of influences and potential connections.

A cultural historical activity theory perspective sees the transformation of a subject, in the case of this study, *teachers' perceptions of influences to either integrate or not integrate technology*, as subject to a variety of external and internal forces occurring over time. Activity theory views that subject as influenced by forces coming from both within the immediate sphere of influence as well as coming from outside that region, essentially coming from activity triangles outside of that of the participant. As a result of those forces, the subject is interacted upon and is transformed to reach a final objective. Factors that positively impact the decision to use technology are referred to as influences; those forces that challenge or work in opposition to the integration of technology are referred to as contradictions (Engeström, 2001; Center for Activity Theory and Developmental Work Research, 2004). Lim and Hang (2001) cite Engeström (1999) in their description of contradictions as "developmentally significant and exist in the form of resistance to achieving the goals of the intended activity and as emerging dilemmas, disturbances, and dis-coordinations" (p. 52). Figure 4 demonstrates this model, building on Figure 3's adaptation of Hoy & Miskel's teaching and learning environment as an open system, but now representing the three participants as activity triangles within the larger activity triangle made up of the Coveside teaching and learning environment itself.

Kaptelinin and Nardi (2006) argue that activity theory is especially well suited to studying the interactions of humans with technology, providing a vantage point that blends technology, context, and action. They explain:

> In activity theory *people* act *with* technology; technologies are both designed and used in the context of people with intentions and desires. People act as *subjects* in the world, constructing and instantiating their intentions and desires as *objects*. Activity theory casts the relationship between people and tools of one of *mediation*; tools mediate between people and the world. (p. 10)

In my examinations of potential frameworks of analysis, I had considered grounded theory (Glaser, 2000) but was struck by the analytical framework's absence of a definable system that would enable me to categorize and represent the variety of influences involved in this study, particularly as participants discussed changes that had occurred over time, as a result of multiple influences from diverse points of origination. Activity theory's fundamental principal is that change occurs to a subject over time and through multiple inputs (Lim & Hang, 2001; Engeström, 2001), whereas grounded theory looks more at a phenomenon *in situ*. I also considered ecological theory, which attempts to examine a participant's actions within the environment and with connection to directly influencing factors (Bronfenbrenner, 1979, 1995; Zhao & Frank, 2003). One key difference between ecological and activity theory is that in the former, technology is seen as an entrant into the environment with its own reverberating forces and ramifications. In activity theory, however, technology is viewed as a tool which may either be grasped by the participant or left alone; it is one of many factors potentially influencing the subject as a mediating tool in its transformation to the objective. Either way, activity theory creates a more visual framework which allows for a clear articulation of the relationships between technology as a tool, combined with the other forces at work on the subject, rather than viewing technology as a subject in itself (Kaptelinin and Nardi, 2006).

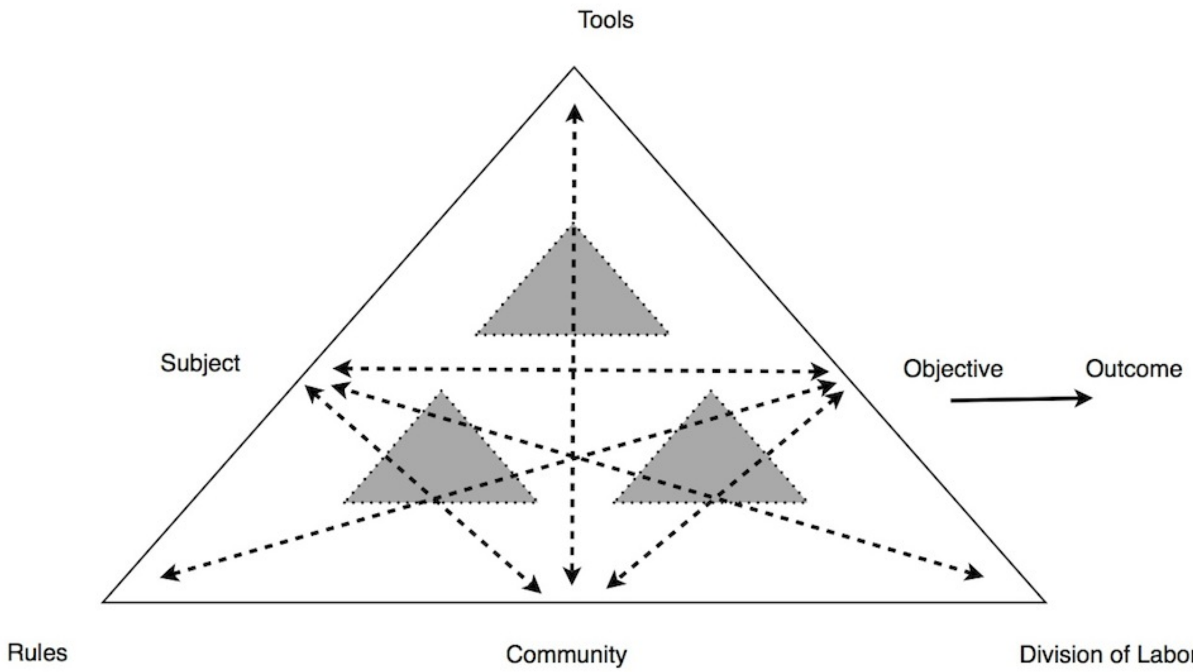

Figure 4. Multiple system model. The researcher has modified Engstrom's model of the activity system (1987) to reveal multiple individual activity systems representing participants as individuals (inner triangles) and the teaching and learning environment in which they and their students operate as a whole through the overall triangle.

Activity theory argues that decisions - indeed, any actions - do not happen in isolation, but rather they are formed through direct connection to the rules of the society, influences from members of the community, the tools and technology available, the responsibilities and duties of the main player involved in the activity, interactions with others, and in the course of conducting activity within an environment, the rules and conventions of that society (Engeström, 1987, 2001). In addition to those influences from within the triangle formed by norms for the community, tools and technology available, job requirements or obligations, and community members themselves, similar factors from outside of that sphere of influence act on the transformation of the subject as it moves toward the objective. Those forces come from identical, yet external sectors, essentially, external activity triangles acting on the one under study (Engeström, 2001). Engeström's revisions of traditional cultural historical activity theory (2001), and the enhancements of additional researchers (Mwanza, 2001; Yamagata-Lynch, 2010) have helped develop a model I employ for this analysis, examining the activity triangles representing both the interior forces and those external to the immediate community where the teacher operates. It is in that framework that I seek to identify *contradictions*, those forces that work at odds to the attainment of the *objective*, as well as the forces that drive the achievement of that transformation of the subject to the objective (Murphy & Manzanares, 2008, Yamagata-Lynch, 2010). Figure 4 illustrates this analytic framework, essentially transferring activity triangles for the circles used to represent participants in Figure 3 to better represent the co-existing and interacting activity triangles within the entire system. Engeström identifies contradictions as "historically accumulating structural tensions within and between activity systems," (p. 137) creating "disturbances and conflicts, but also innovative attempts to change the activity," (Kuutti, 1996, p. 34). It is the search for those contradictions that lies at the heart of this research, and it is activity theory's focus on identifying those forces that makes this the ideal analytical framework. In Chapter 4 I discuss contradictions and their role in the development of activity in further detail.

Study Context

Coveside Middle School, the study location, is a 600-student school in rural Maine, and one of two middle schools in a 2,800 student district. Coveside mirrors the other six schools in the district in its demographics. Approximately 98 percent of students are white, and of the 586 student population, 28.8 percent qualify for free or reduced lunch prices under federal guidelines, according to the most recent data available, that for the 2009-20010 academic year. The school employs 48.7 teachers, providing a 12:1 student to teacher ratio. CMS is located in a county which has a median household income of $43,913, approximately 5 percent under the state average of $45,832. Thirteen percent of county residents live under the federal poverty line, slightly more than the state 12.2 percent average. The region's housing base also trails the state average, with the median housing valuation at $87,200, 12 percent under the state's $98,700 average (U.S. Census Bureau, 2008). Because this data was collected prior to the economic decline experienced in 2009-2011, the information presented above is likely to represent a better economic situation for the area than existed at the time the research took place.

Several developments occurred at Coveside just prior to the study which impacted the available pool of participants. Teachers had been arranged in grade-level teams -- single-year teams for sixth grade and looping teams for seventh and eighth grades. At the close of the 2009-2010 school year, the Board of Education considered a plan to move many of the district's fifth grade students into the school, forcing widespread moves for existing middle school teams, and prompting a realignment of many teaching teams. Some teachers who were queried about their willingness to join the study expressed reservations due to the uncertainty of teaching assignments for the school year because of the pending shift. While the Board of Education rejected that move just before the study commenced, the potential for a significant change in staffing arrangements narrowed the pool of potential participants.

Another complication came after participants were selected and the research phase of the study was nearly under way. The district embarked on a five-year plan to develop a performance-based system that would advance students based on demonstration of proficiency, rather than completion of academic courses or school years. One participant withdrew his decision to participate in my study when this initiative was announced and said he feared that the redesign would further complicate his teaching schedule, making the time required for this research a difficult burden.

The unfolding of the school redesign movement began a shift in the focus of faculty meetings, curriculum development, and the allotment of professional development opportunities. The transformation of the educational approach also became the focus of much of the communication from administration to teachers. Prior to the launch of this initiative, faculty meetings and professional development opportunities within the Coveside district had in part been dedicated to technology integration. Those avenues largely vanished with the advent of the instructional redesign program, eliminating what I had expected to be a contributing part of my data source. In addition, changes at the state and district level leadership ended a practice of forwarding state research reports and policy documents to classroom teachers. In prior years, classroom teachers could expect to receive notice of research connecting technology to literacy achievement, or notice of new state policy or initiatives, but that practice ceased during the year this study took place.

Another personnel issue existed at the time of this study which must be taken into account as a potential limitation, something I discuss in further detail in Chapter 5: teachers in the Coveside district had been entering the second in a three-year contract dispute. Salaries had not changed in more than a year, and disputes over contractual language regarding seniority, tenure, and professional duties were straining negotiations. Approximately 70 percent of Coveside teachers are members of their education union. I did not inquire about the participants' membership in the association, nor did I or participants raise the contract issue during the study.

Justification for the Site Selection

The study was situated at Coveside for several reasons. The school has engaged in the Maine Learning Technology Initiative computer program since the state program first equipped all seventh and eighth grade students, along with their teachers, with Apple laptops in 2002. At the start of the 2010-2011 academic year, the school was taking part in the eighth year of the program, and the district had joined in subsequent initiatives that enabled equipping all students grades 6-12 with a laptop computer and providing high-speed Internet to district schools.

At the time of the study, all sixth, seventh and eighth grade students at Coveside Middle had Apple computers assigned to them for the full academic year; seventh and eighth grade students had possession of the laptops full-time and were responsible for bringing them both to school and home each day. Sixth grade students were assigned computers for the school year, but were not allowed to take them home or use them except in classes or study hall periods held at the end of each day. In order for students to bring their computers home, parents had to either pay a $40 fee for insurance in the event of accidental damage, or sign a waiver assuming financial responsibility for damage to the machine, a cost of up to $1,200. District budgeting and technology redistribution priorities made the school system a 1:1 laptop environment in grades 6-12 during the 2010-2011 year, and all teachers in grades K-12 had been provided with laptop computers. Through state funding, the district offered free Internet access to income-qualified families. As of the start of the 2010-2011 school year, 89 percent of Coveside students reported they had Internet access available at home (Coveside Technology Plan, 2011).

Coveside's eight-year history with a pervasive atmosphere of educational technology established the institution as an environment where technology was well rooted, at least in principle, and extensively available throughout the teaching and learning environment. Administrators could frequently be seen using portable communication devices, iPods, tablet computers, and cell phones. In addition, the school's administration provided information via electronic parent newsletters and had sponsored several community dinner conversations around technology issues relevant for parents, including gaming, texting, and Internet safety, at times bringing in educators from the University of Maine to lead the programs. The school's administration had also focused three technology-based workshops for faculty in the year prior to the study, including such personal and professional applications as use of Facebook, podcasting, photo editing, digital storytelling, Skype, sharing photos online, and video conferencing.

In addition to the opportunity to attend periodic technology seminars offered locally after school, all staff at the school were eligible to take part in week-long technology institutes offered during the two summers prior to the study. Those opportunities ended when the district shifted its priorities to the proficiency-based learning project, replacing the summer technology institute with training for the district redesign program. While the integration level of technology varied among teachers and teaching teams, the school offered a research environment where technology had been available over the long term, and where administrators had a track record of support for its integration.

As a site for this study, Coveside also offered a pool of potential participants representing a full range of technology integration experience and practice. Some were recognized innovators; one team of four educators had been nominated for the 2010 Instructional Technology Educator of the Year Award presented by the Association of Computer Technology Educators of Maine. The school also had the largest number of participating teachers on the district's Moodle platform, the learning management portal that provides online space and resources for online course creation; 20 CMS teachers had classroom sites on Moodle in the 2010-2011 academic year, though they were used to varying degrees.

These factors, the history of support for technology, the physical infrastructure, financial, political and pedagogical support for teaching and learning with technology, created a research environment where a number of steps had been taken to ensure that students and teachers had access to technology and the support for its implementation in creating learning experiences. Coveside was not a place where a teacher using computers in the classroom would be breaking new ground. While a specific use might be pioneering, the fact that teachers and students at Coveside were surrounded by technology helps make the results of this research important for those school systems that might be moving toward the creation of such an ubiquitous technology atmosphere as that provided at the study site. My research inquiry begins at a point beyond the implementation of a technology program, after the physical equipment is in place, looking at what lies behind the decisions of whether or not to put that infrastructure to use. For those reasons, Coveside provided an ideal environment for this study to take place.

Personal contacts with colleagues at the school and its proximity to my own workplace, a nearby high school, also made Coveside an ideal environment for this research, since I could easily access participants and develop an understanding of the environment while employed as a full-time classroom teacher in the district.

Participant Selection

The study's three participants were selected for their diverse representation of the teaching staff in terms of levels of technology use in teaching, experience in education, and in representation of literacy-connected content areas. The participants taught children in grades seven and eight, and had shared contact with a mix of the students. They also represented a broad spectrum of self-identified comfort and competency with educational and personal technology. All study participants were white, the same race as the researcher, as were all teachers at the school at the time of the study.

Wendy was a long-time technology user and steady integrator. A seventh and eighth grade language arts teacher with more than a decade of experience, she had attended numerous conferences focused on educational computing, and described herself as someone who steadily used technology both in her professional and personal life. **Julie**, a science and mathematics teacher, acknowledged that she was still growing comfortable in finding ways for her students to use computers in her instruction. She had attended district technology workshops, including a special summer teacher training program, and said those experiences had helped her develop new skills both for her personal and professional life, but described herself as still adapting to teaching with technology. **Brian**, a seventh and eighth grade science and social studies teacher, had taught for fewer than five years. He reported that he used technology steadily in his personal life, and consistently in his teaching, though said he did not consider himself fully at ease in determining when and how he would use computers with students.

Participants were sought for this study who routinely employed technology in their instruction or steadily experimented with finding ways to use computers in the classroom – either for themselves or their students. The three specific participants were selected because of their literacy-intensive approaches to instruction - one specific interest of this study, their diverse experiences with technology integration, and their willingness to participate as well as compatibility with my research schedule. The participants were educators whom I had known personally through various collective staff endeavors, or whose work with children and computers I had heard about through either district newsletters, conversations with colleagues, or other means. I did not ask teachers to be participants in this study if I knew they did not employ technology in their teaching or allow children to access their computers for classes. While a future study might target just these individuals, I believed I would best find an answer to my research question by focusing on individuals who already integrated computers since there are so many levels to which that takes place; thus, a complete absence of allowing technology in the classroom disqualified prospective participants from consideration.

Participants were initially asked either in person or via email if they would consider taking part in the study. I provided prospective participants an overall description of my research, specifically laying out the time and access commitments. Participants agreed to take part in three interviews of about 45-60 minutes each, and granted me access to their classroom for scheduled observations. Those taking part in the study agreed to conditions of an Informed Consent (Appendix A). To preserve confidentiality, pseudonyms have been used for the district, school, and participants in the study; in addition, some details about the participants have either been intentionally obscured or altered to prevent identification.

Two of the participants had experience teaching in settings without 1:1 computing. Wendy had taught continuously at Coveside since before the start of the MLTI laptop initiative, and Julie also had teaching experience in schools without 1:1 computing. Brian was the sole participant to have only taught in schools with full-time computer-access for all students. During my study, the participants, while teaching in three different content areas, all had the same access to equipment - digital projectors, speakers, and a laptop, as well as the same software access, regardless of content area. The district annually modifies and expands the state-issued computer software package, providing students and teachers access to a variety of open source and private-label software, including applications for animation, website creation, audio production and engineering, and video creation, among others. Teachers have generally not been allowed to add additional software to their computers unless obtaining specific permission from the technology administrator. Of the three participants, only Wendy has sought and received authorization for modified software.

Data Gathering

Data was gathered using naturalistic inquiry methods (Lincoln & Guba, 1985) and involved triangulating data (Patton, 2002) from interview, observation, and to a limited extent, document analysis, so that a multi-perspective view of the participants' experiences might be developed, and so that a measure of validity is built into the design of this study. I discuss steps I took to build validity and reliability into this research later in this chapter.

Interviews

Just as observable incidents give researchers empirical data, so do the words of participants obtained through interview. Schiffrin (1994) considers discourse a "social interactional phenomenon" (p. 415) that provides measurable data capable of undergoing analysis when considered in the context of which it is uttered. Coding the language of participants means much more than simply looking for references to issues under study; it also involves looking at how participants describe the situations in which the influences arise, the relationships and environments involved, and the outcomes arising as a result of those influences. A researcher is required to look at "not just utterances, but the way utterances (including the language used in them) are activities embedded in social interaction" (p. 415). That use of language in context blends well with the analytical framework I employ in this study, and I present findings in Chapter 4 both reflective of the language participants use, as well as the social context in which they use it.

Much like activity theory examines the exertion of societal influences on a subject, discourse analysis examines the linguistic vocalizations of the participants both with sociocultural meanings and contextual frameworks. The analysis of interview transcripts requires a willingness to explore intentions of the speaker, conversational methods speakers use to be understood, context of the utterance, properties of the discourse, the social context - the relationships involved in the discussion as well as those being referred to, and the speaker's intention (Shiffren, 1994).

Researchers can examine discourse collected from a variety of sources, and Shiffren suggests that more than one text type should be considered. While my participants and I interacted in a standard, question-answer interview format, at times their answers stepped into narrative, repairs to previous responses, and clarifications or forays into related topics. Shiffren also advocates that researchers transcribe and code "institutional talk," the kind of working, professional encounters that takes place in non-interview settings, as well as the analysis of written discourse. I take on both avenues to the degree applicable by examining the Coveside principal's parent night talk as well as a superintendent's presentation, examples of "institutional talk" the participants are a party to and which they all discuss. Those findings are reported in Chapter 4.

Interviews were digitally recorded from October, 2010 to January, 2011 and transcription was completed by the end of January, 2011. All interviews took place in private settings after participant teachers had concluded their working day. Each participant was interviewed individually three times over the course of the six month study, with an interval of approximately two weeks between interviews. Participants were not provided with questions in advance, but were given brief descriptions of the types of queries I would be asking.

I developed interview questions by first devising a series of sub-questions based on my original, overall research question discussed in Chapter 1:

- How do perceptions of expectations and pressures of community stakeholders (students, parents, community members) influence the integration of educational technology?
- How do perceptions of expectations and pressures from colleagues affect the integration of educational technology?
- How do perceptions of district and school-level administrative initiatives, policy directives and influences affect the integration of educational technology?
- How do perceptions of state-level initiatives, policy directives and influences affect the integration of educational technology?

My sub-questions helped develop three research categories: general instructional technology use and availability, perceived influences from students, parents, and other teachers on the instructional or grade-level team, and perceived influences from colleagues, building, district, and state-level policies and administrations. I then developed more specific questions under each category, revising as necessary so that I would elicit responses that would directly inform the sub-questions. Miles and Huberman (1994) suggest that it can be easier to develop a conceptual framework after first developing a list of research questions, but I found the specific categories created through these sub-questions confirmed the selection of activity theory as an appropriate framework, since these queries help build the triad that is the hallmark of the activity theory triangle.

So that my data was consistently gathered, I asked the same questions of each participant, with the exception of some follow-up, clarifying questions necessitated by a particular response. Interviews took place in the participant's classrooms, a setting that offered a degree of privacy, limited interruption, and both convenience and comfort for participants. Frequently, participants made references to different assignments or strategies posted in their room that prompted them both with their development of a response, as well as illustrated an example for me. Interview questions are listed in Appendix B.

In addition to digitally recording each interview, I also took extensive notes in case a response was inaudible during the transcription process, or in the event that clarification was needed for me to fully understand a response. Patton (2002) suggests that examining those notes while the interview is still easily recalled helps the researcher reflect on the responses and think about how, at a pre-coding stage, some of the data might feed an ultimate response to the research questions. After each interview, I reviewed those notes to ensure that I understood the responses and to begin thinking about how those responses were building a basis for the analysis to come, as well as how they contributed to telling the participant's story. I made it a point to transcribe the interview recordings as soon as possible after each session, giving me yet another opportunity to verify and reflect on the data soon after it was gathered. That transcription process also helped me see which of the codes might start to seem especially relevant later in the data analysis process.

Observations

Observations in the participants' regularly scheduled classes took place on the day following each interview, except on two occasions due to scheduling conflicts when they were postponed. The arrangement of observations closely following interviews was made for scheduling purposes, consistency, and as one more way to best identify connections in the data while the preceding conversation was still fresh in my mind. Those observations each lasted 45 minutes, close to the length of a class period. During those sessions, I assumed the role of a privileged observer (Wolcott, 1988), taking field notes on student and teacher use of technology, availability of technology, and interactions between students and the participating teacher around the use of educational technology. The decision to schedule observations the day following each interview was made to develop a pattern of consistency and aid with organization. The practice also gave me the opportunity to connect ideas that participants spoke about during interviews with observable classroom practice.

Observations were holistic (Marshall & Rossman, 2006) in that they focused on general patterns of student and teacher use of technology. Observations were arranged to begin just after classes had started, and depending on the seating arrangement and classroom layout, I usually took a corner seat that offered me as broad perspective as possible. I made it a point to generate an overall description of the environment, noting especially the technology available, including student notebook computers, projection stations, announcements or advertisements for technology-related activities or assignments, and obvious, visible directions that might indicate a presence or intended use of educational technology, giving me a macro-level view of the technology available within the classroom. I guided my observations using the Observation Protocol (Appendix C) so that I was conscious of looking for specific interactions between participants, technology, and their students. The protocol also served as a guide to develop code frequencies for observations and subsequent inclusion in the activity triangle analysis.

I took extensive field notes during each observation. Patton (2002) suggests that field notes contain “insights, interpretations, beginning analyses, and working hypotheses about what is happening in the setting and what it means” (p. 304). During the observations, I attempted to record as much as possible about teacher and student use of technology, participant references to technology, its implementation or decisions against its use, and student comments or actions that either supported the instructional use of technology, or in some way worked against it. During most observations, students were working on common tasks, so a global view of the room provided me with general data and enabled me to take notes that reflected the behavior or actions of a number of students at once, rather than needing to focus on the individual actions of either a select group or full classroom of students.

Immediately following each observation, I took additional time to annotate my field notes with marginalia, reflecting on what I had seen by adding additional comments that I might not have fully developed during the interview. I found the extra time spent after each observation helpful in bridging connections between specific incidents noted in the classroom with other comments from the participant in a prior interview. That reflective and analytical time aided me in building an overall picture of the teacher's technology use and helped me connect, when possible, their stated perceptions with their actions and those of their students in the classroom. Annotated observational field notes were coded using a selection of codes (Appendix E) drawn from the larger group used for interviews (Appendix D).

Participants were offered the opportunity to review my observation notes; while no participant accepted that offer, I asked participants if there was anything they wished me to directly note. Two participants, Brian and Julie, both wanted me to understand that technical problems that occurred during two separate observed lessons, preventing students from accessing a planned learning activity, had been solved by the school's integration specialist. Brian had asked that I note the conditions around one observation which resulted in a large number of student behavior issues coded as negative actions related to technology use. During that observation, nearly 25 instances of negative behavior, “student action demonstrating opposition for technology integration,” were recorded. That class had a large number of students with behavior modification plans, and when the school experienced a network outage, many of those students lost work in progress. Brian said he feared that the large number of negative codes stemming from that day could be seen as a classroom management issue, but I told him I would note the conditions in my observation notes. I discuss this issue more in my findings in Chapter 4 and in the implications for further study suggested in Chapter 5.

Of the nine observations, only one session involved a class in which no technology was employed by, or referenced by either teacher or students. So that I could give a clear and accurate picture of technology use, or lack thereof, in the participants’ classrooms, I made the decision early on in the development of this study that I would conduct observations regardless of whether technology was planned for the lesson or not. I also made it a point to ask participants not to change their plans because I would be in their classroom; I informed them that they would help me present a fair and accurate picture of the technology usage in their classroom by continuing with their regular plans rather than adjusting them because I was observing. Participants told their students that I would be in their classrooms several times as part of a research study on the use of technology in education.

Documents

When I originally designed this study, I expected that truly measuring educators’ perceptions of technology influences would require the analysis of a number of documents that participants would have seen which might have had a role in shaping perceptions of influences to use technology. I expected that budget documents, a district technology plan, communiques from district and state Department of Education leadership all would have relevance. In addition, I expected that participants would have been either acquainted with, or active readers of, a number of research papers produced on behalf of the Maine Learning Technology Initiative, some of which I discuss in Chapter 2. I also expected that a series of podcasts produced by Coveside Middle's principal and posted to the school website would have been potentially influential in shaping teachers' perceptions, especially since he had been a vocal advocate of technology usage. Finally, I anticipated that either technology-related documents arising from faculty meetings or relevant discussions emanating from the meetings themselves would prove worthy of analysis.

But those expectations did not prove valid. Participants reported that they had not come across any of the documents in question. A change in district leadership ended a longtime practice of disseminating state-level policy and research documents to classroom teachers, and a shift in district priorities ended ongoing technology-focused staff meetings. All three participants reported that they had never listened to the podcasts produced by their school principal. One participant noted that he had little time to listen to the recordings.

While the documents in question would have likely yielded robust data that would inform my study, the fact almost none of them had been seen by the participants made them irrelevant as potential influences. I did, however, code two documents viewed or heard by all three participants, a multimedia presentation by the district superintendent and a parent's night presentation by the school principal. Both of those are relevant because they come from key players within the participants' environment, people who hold key roles in the activity triangles for each participant. Codes for those documents were gleaned from my interview code bank which appears in Appendix D.

Managing Data

Interviews were recorded using a handheld digital audio recorder. Those files were transferred to my personal computer and deleted from the recording device. Both my computer and relevant project folders are password protected. I transcribed each interview within two weeks of each session, and after verifying the accuracy of the transcription, ensured that any identifying data had been removed. All interviews were fully transcribed by the end of January, 2011, and coding was completed by October, 2011. In addition, I was cautious not to include any identifying data in the creation of my observational field notes. Those fully de-identified notes are held in a secure cabinet in a home office. All audio recordings will be deleted from my computer on acceptance of this dissertation.

Data Analysis

Miles and Huberman (1994) consider triangulation of data "not so much a tactic as a way of life" (p. 267). They call the process one of "analytic induction" with a built-in verification process that has the researcher seeking evidence using a variety of methods from multiple sources and types of data. Activity theory, by its use of analytical triangles as an organizational framework, provides a method of visualization that continues the triangulation inherent in my data gathering through to the analytical stage. Throughout this study, I sought data from interviews, observations, and documents, and through coding transcripts, observational field notes, and relevant documents, as well as reflections in my research journal, checked that I was gathering data in response to the respective research questions. That process was in part made visible through the analytical triangles, since the coding categories aligned with relevant research questions and segments on the triangles I was creating to analyze my data.

I employed a deductive approach to analyze data, generating a bank of prospective codes as a framework for an activity theory analysis (Nardi, 1996; Yamagata-Lynch, 2010). I generated a master list of codes from the interview questions developed from my four research sub-questions mentioned earlier. Those sub-questions provided ideal categories from which to work. I revised that list of codes for relevance, and then continued to refine that collection as I began examining transcripts. Once a suitable code list (Appendix D) was in place, I developed a code dictionary (Appendix F) to provide readers with an understanding of how I was organizing data. As noted, data sources coded included interview transcripts, observational fieldnotes, and several relevant documents.

To facilitate and help organize the process of coding, I used the open source computer program Open Code, developed by the Department of Public Health and Clinical Medicine at Umeå University in Sweden, to assist me in manually assigning codes and generating frequency lists for each one. Using Open Code, I assigned relevant codes to passages of text approximately five words in length. Open Code allows users to determine the length of text passage to code, and I tried various parameters, settling on a five-word passage as the optimum length that allowed me to assign codes to only the relevant text, avoiding the assignment of codes to extraneous text. Codes are mutually exclusive, and I was careful to be selective in coding, assigning only one code to each text passage.

In addition to assigning codes to text, Open Code allows the user to create memos assigned to the relevant passages. That proved helpful, since I frequently found myself making marginalia notes alongside passages of transcribed text (Miles & Huberman, 1994) noting similarities to other passages or identifying points for further consideration. Most commonly, I added notes to the transcripts after rereading the interview and verifying that I had assigned the most appropriate codes to each passage.

Once the codes were assigned, I developed a series of activity triangles (Nardi, 1996; Yamagata-Lynch, 2010) to get an overall sense of which codes appeared with the greatest frequency, and to begin examining the potential influences and contradictions within the activity systems. Graphical representation of data is helpful for researchers to be able to see patterns and trends (Miles & Huberman, 1994), and activity triangles are a graphic cornerstone of analysis in activity theory. As a check on the construction of activity triangles that ensured the categories I had identified matched the designated components of the Engeström-design triangles, I employed Mwanza's (2002) eight-step-model, a series of open ended questions for identifying the segments of the activity triangle model. Mwanza's protocol calls for identifying specific characteristics of the subject under study, the rules of the environment in which the study takes place, the composition of the community which the subject is a part of, the tools available to impact the subject, and the roles and responsibilities - the division of labor, linked to the subject under study. Mwanza's process served as a validating framework for the construction of the activity triangles and their connection to my data.

With transcripts coded, I entered the frequencies for each code first on two activity triangles for each participant, one representing forces directly internal to the participant's classroom and teaching environment, and one representing external influences (Engeström, 1999). In Figure 5, I present as an example, the codes aligned on an activity triangle for internal forces gleaned from interviews with Wendy, a participant.

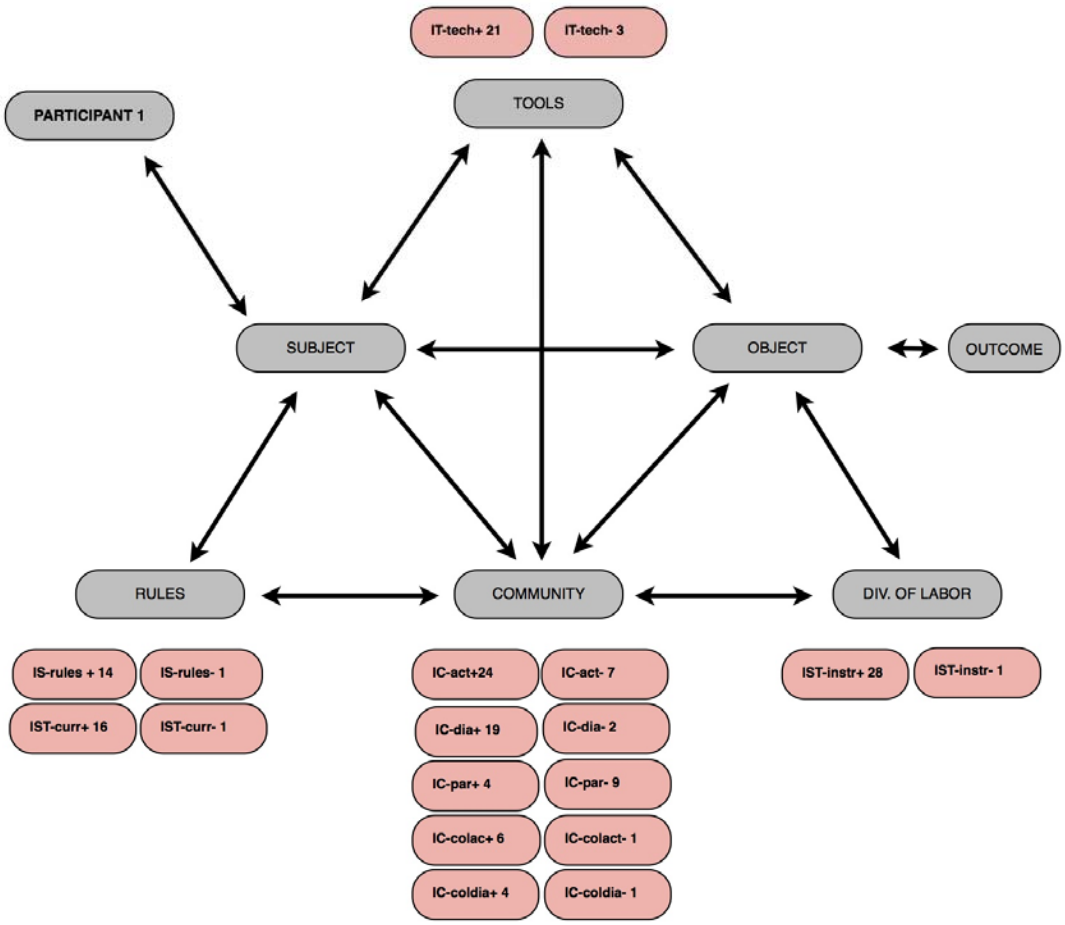

Figure 5. Internal coding example. Codes representative of the internal forces presenting influences and contradictions for Wendy, one of the participants, are visible aligned to the corresponding sectors of the activity triangle developed for analysis. I created activity triangles drawn from interviews and observations, coding for both external and internal sources.

The graphical arrangement of data enabled me to visually gauge the origins of the influences and contradictions each participant discussed. That aggregation and organization of data helped me identify some of the strongest influences discussed by participants. It also allowed me to look at the data within a framework (Miles &

Huberman, 1994) to explore factors originating (Engeström, 2001) from within the activity triangle - the classroom and teaching environment, and those forces influencing the activity triangle from outside, forces external to the classroom and teaching environment. I identified external influences as those from teachers and others not involved in the participant's immediate instructional teams. That included those from administrators, the technology integration specialist, students not under the instruction of the participant, and community members and others not involved in the immediate classroom community. External forces also included the imposition or limitation of technology issues not under the participant teacher's immediate control. For example, network or connectivity issues were classified as external, while a teacher discussing her use of a projector within her classroom was coded as an internal influence.

In addition, I manually coded observation field notes using a narrower group of codes (Appendix E). Those codes were plotted on separate activity triangles that represented findings specific to each participant. I also coded two documents mentioned earlier in this section, an opening presentation by the Coveside superintendent of schools, and a parent's night speech by the middle school principal. Participants were present for both talks, and each teacher spoke about their impressions of the two presentations during interviews. Once I developed activity triangles for internal and external influences, observational field notes, and included codes pertaining to the documents, I created a fourth activity triangle with combined code frequencies for interviews, observations, and documents for each participant. That final aggregation of data helped me see overall sources of influences or contradictions for each participant, enabling me to see their stories of technology integration through the combined windows of interview, observation, and document. That visual conglomeration of data made visible the sources of greatest influences and strongest contradictions on the participant teachers' perceptions.

Internal Validity

Throughout my study, I kept a research journal to explore my own thinking about this project, the way I was going about my work, both keeping track of the research under way and my own ideas about the process. I began that journal at the design stage of this study after finding that writing was critical to framing my research question, and knew that writing about the process under way would help me build both direction and reflection, helping me remain focused on searching for the answers my research question was specifically designed to answer.

I also conducted member checks, offering participants a chance to review transcripts of interviews. One participant accepted that offer and found no inconsistencies in the transcript and her recollection of the interview. Her one expressed concern was that she not be quoted in a way that revealed a large number of the verbal hesitations such as "um," and "aah," that are inherent in verbatim transcripts. I assured her that I expected my use of direct quotations would be minimal and that I would be conscious of how I was portraying participants, either intentionally or inadvertently. I also offered to show her the final quotations I expected to use from her interviews in the final report, but she said that would not be necessary.

I also offered participants an opportunity to review the activity triangles representing my classroom observations and to make suggestions for changes that might better reflect their recollection. As noted earlier, one participant, Brian, said he was concerned that the high number of incidents coded as student action in opposition to technology use might reflect negatively on his teaching practice, and asked that I emphasize that the class had a large number of students with either behavior modification or special education plans.

External Validity

The code dictionary was especially useful so that I could inform other coders solicited to validate my results. To test the external reliability of my coding, I sought and received the participation of two post-graduate researchers who were unfamiliar with my study and enlisted their help in coding portions of de-identified transcripts totaling five pages. I used the code dictionary to guide them through the process of coding and asked that they review the transcript, noting text with applicable codes. Inter-coder agreement rated 83 percent for analysis of comparable data, using a reliability index recommended by Miles and Huberman (1994).

Researcher Perspective and Bias

As an educator and researcher, I come to this study with an acknowledged bias: students today need to learn in, and use the tools of the world they will experience outside of the walls of their classroom. As I acknowledge in Chapter 1, I believe that students' learning experiences must access, and when effective, mirror, the world around them. That means having the freedom to seek outside content experts, like the collaborative wisdom offered through Wikipedia or a virtual museum tour with a live docent connected via teleconference. It means having the chance to collaborate with peers on a multi-sensory project that engages learners of different types - those with visual, auditory, or verbal skills, and it means taking part in the participatory culture of the 21st century by both accessing and contributing to the online media that directs politics, fashion, communication and design today. I agree with Jenkins et al. (2007) in their assessment of the new digital divide: it is no longer a schism of those with computers and those without, but those allowed to take part in participatory culture and those denied that access.

But this is not a study about whether educators should or should not use technology in their instruction, and because of that, my inherent bias in support of technology use is not one that has an impact on the results of this study. I have been careful as I listened to the stories of teachers and their experiences implementing technology to withhold judgment on their efficacy or their approach, but instead to hear their experiences as they discussed those people and experiences that either prompted them to reach for computers, or avoid their use. This study was not a quest to support technology integration or critique its use, but rather a search to understand the motivations of teachers, and examine the influences and contradictions that shape their decisions.

It should be noted that during the study, three of my children attended Coveside, however none of them had contact with or instruction from any of the teachers involved in this research. While I have developed judgments about my children's educators and their teaching methods - influenced through both my perspective as a parent and as an education professional, those perspectives do not extend to the participants in this study. Likewise, as mentioned earlier, while I work in the same district as the participants, I have had only limited contact with them as professionals. I recognize that my role is as researcher, not critic or endorser, and have been conscious of my own biases and beliefs so that they not obscure my ability to report findings that truly reflect the experiences of my participants.

Limitations

This study is limited in several ways. The use of a single researcher, rather than a team, offers an inherently narrowed perspective. In spite of a persistent awareness of the potential for bias both through the gathering and analysis of information, a researcher working alone brings that single-window view to a project such as this. However, I tried to stay aware of that lens through reflective journaling, a steadfast determination to tell the participants' stories, and measures of validity and reliability, keeping me accountable to the participants, their data, and the theory through which I provided an analysis. I also used member checks as a measure of internal validity at several stages of the process, and solicited other researchers to establish validity in coding, creating a triple-level of inter-rater reliability.

Another limitation comes in both the number of participants as well as the ability to truly measure all influences or contradictions coming into their frames of reference. A more exhaustive look at the research question might use multiple researchers to survey a broader number of participants from a more diverse range over a greater period of time, as well as provide increased measures to gauge their perspectives.

Implications

As suggested in Chapter 2, technology is a key factor in students' ability to participate in the world beyond the classroom, both to access mentors and resources and to contribute to the collective endeavors of a digitized, hyperlinked world. This study provided insights into part of what makes some classrooms places where technology is a commonly accessed tool for learning, and how in spite of obstacles, teachers persist with innovative digital approaches. As a converse, the study also offered insights into why sometimes educators make the decision not to use technology as a tool in their students' learning arsenal. The study has relevance for program leaders contemplating the creation of environments where an immersive computing program or other significant investment in educational technology is being considered, and may also be applicable for those districts with computing programs already in place that are looking for insights to improve pedagogical use. My findings will inform education policymakers, along with district and building leaders in the creation of learning environments where technology is envisioned as a central, essential component.

Conclusion

I sought to collect and understand middle school educators' perceptions of the forces that might influence them to use or avoid classroom technology. Through the selection of three participants willing to both offer their time for interviews and access to their classrooms for observation, I was able to gain insights into some of the influences and contradictions at work. I sought out a location for this study which held a longtime institutional investment in educational technology and cultural support for its use. I also sought out a vast array of documents and experiences that I believed might have weighed on this decision, and through the analytical lens of activity theory and the development of activity triangles, examined how those influences supported or contradicted the decision to integrate instructional technology. I discuss those findings in the following chapter.

CHAPTER 4: RESULTS

Research Summary

This study was designed to examine how middle school educators' degree of technology integration is shaped by their perceptions of internal and external influences from a variety of sources, including technical, curricular, student, community and peer-based. In addition, the study examines those sources emanating from the structure of the teaching workload itself.

This study began with an overarching question: ***How are educators' decisions to integrate technology in a 1:1 laptop middle school shaped by their perceptions of internal and external influences from students, community, colleagues, and administration?*** I sought to understand why some teachers use technology in a transformative, disruptive means; their classrooms are places where students learn in innovative, creative ways that challenge the traditional roles with teacher as dispenser of knowledge and student as receptor. These classrooms are places where students do not use a computer to take a multiple choice test, but demonstrate their knowledge through the creation of simulations, video, or interactive writing for a variety of authentic audiences. I also wanted to understand why some teachers, even when they and their students are surrounded by computers - an immersive computing environment - might still consider having students disconnect and leave their technology aside, favoring traditional learning approaches and demonstrations of knowledge made without technology.

In order to uncover answers to that overarching question, I focused my inquiry through four sub-questions:

- How do perceptions of expectations and pressures of community stakeholders (students, parents, community members) influence the integration of educational technology?
- How do perceptions of expectations and pressures from colleagues affect the integration of educational technology?
- How do perceptions of district and school-level administrative initiatives, policy directives and influences affect the integration of educational technology?
- How do perceptions of state-level initiatives, policy directives and influences affect the integration of educational technology?

Drawing from my own experience as a classroom teacher who has used educational technology for a decade, my insights as parent with a wide range of insights, and as a professional development leader and consultant focusing on literacy and technology integration, I have suspected over the years that the decision to use technology with students isn't an easy one made in isolation. Rather, based on my experience gained as a classroom educator, I have come to believe that it is one made based on a number of factors not always identifiable at the moment the die is cast, the switch flipped on. Factors from availability of computers to interactions with colleagues, students, parents, or administrators have come into play in my own decisions, and the teachers in this study echo similar experiences. The participants cite factors like the behavior of their students, teaching demonstrations of their peers, involvement of technology specialists, unreliable computer networks, or use of electronic media by principals as reasons why they use, or set aside, computers in their classrooms.

Interviews with participants offered a large part of the data, but I also found that the opportunity to observe their classrooms provided another glimpse that helped illustrate the participants' answers and provided me with data that might not have been discovered otherwise. In addition, I analyzed two presentations all teachers were exposed to: a district official's multimedia presentation opening the school year, focused on children's learning and the digital age, and the school principal's recorded address presented at a curriculum night for parents just after the start of the school year. I had expected that participants would encounter a large degree of document-based sources of potential influence, but that did not occur.

As I discussed in Chapter 3, I used the qualitative computer software, Open Code, to analyze the data, coding for internal and external influences that either supported technology integration or worked against its use, a factor termed a *"contradiction"* in the analytical framework of cultural historical activity theory. I then created a series of activity triangles (Figure 6), the chief analytical tool of activity theory, to plot the code incidents generated by examining the triangulated data from interview, observation, and document, examining the influences and contradictions both individually and collectively. Relationships among elements are represented through double-ended arrows and a jagged, broken arrow represents the impact of contradictions on the appropriate sector of the activity triangle.

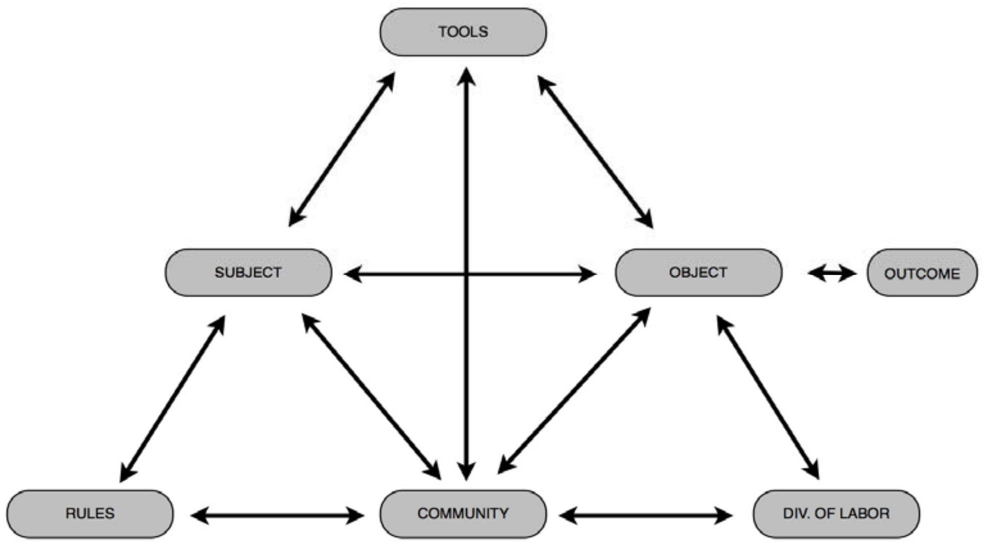

Figure 6. The activity triangle. The graphical analytic representation of activity theory, the activity triangle demonstrates movement of the subject through the process of activity toward reaching the objective, with a resulting outcome. The subject faces influences, or contradictions (forces working against its transformation to object) from societal rules, community members, factors inherent in the roles and responsibilities of the participant, and the mediating tools.

Initially, I had thought that the results of my analysis would be best framed through the four specific sub-questions, then drawn together in an overall conclusion. But on reflection, it became evident that my results are best presented along the framework of the activity triangle, taking full advantage of the analytical approach selected for this study. As I reviewed my data, it became clear that the data aligned with the activity triangle sectors, and presenting results within that breakdown would best enable me to analyze the pressures at work on the subject - the teachers' perceptions - through the transformation to the objective, the decision whether or not to use instructional technology. Thus, I present the results of my study in the four coordinates of the activity triangle, examining the data gathered both internally, or within the confines of the participant's classroom and immediate teaching environs, and externally, or those forces outside that sphere, including the school as a whole, district, and state level influences. I discuss how those separate activity communities connect in Chapter 1. I present my analysis along the four activity triangle quadrants, drawing from interview, observation, and analysis of several relevant documents. Below, I define the sectors of the activity triangle, following each sector with examples of factors from both within the activity system, and from external sources.

- **Rules:** the societal rules, structural norms, or hierarchical system at work in the environment where the activity is taking place.
  - **Internal:** Curriculum, team-based agreements related to instruction, such as common units of study, decisions to segment instruction between teachers within a team, decisions to employ specific instructional strategies or tools within the team.
  - **External:** Building, district, state level rules, policies, administration. This sector included building policies such as common agreements on testing schedules and procedures, state mandates requiring that students be allowed to take laptops home, policies set by administrators regarding faculty meetings, contractual obligations, training schedules and others.
- **Community:** the people involved in the activity system and drawn from external sources able to impact the system under study.

- **Internal:** Actions or dialog from middle school students and their parents, or teachers on the participant's team, such as statements of engagement from students when technology is used, student misbehavior during technology-based tasks, parental disapproval or questioning of computer use, perceived support or disapproval from team teachers.
- **External:** Actions or words from students, parents, community members not affiliated with students assigned to the participant; teachers, other professional colleagues outside of the participant's team teachers. Examples include statements from colleagues questioning technology use, conversations with teachers outside the participant's team advocating technology use or encouraging its implementation.

- **Division of Labor:** the job roles, responsibilities, or work requirements which may regulate the subject.
  - **Internal:** Instructional strategies or techniques employed by the participant within the classroom, such as the development of a science unit using a virtual laboratory or use of the learning management system Moodle which allows students an online arena to access instruction, assignments, and resources, and take part in discussions.
  - **External:** Conditions outside of the teacher's control that may impact instruction. This section would have included external mandates, regulations, or unforeseen provisions that might affect a teacher's ability to perform his or her job, but because codes are mutually exclusive and

due to the nature of such conditions, external sources were coded under the Rules category.

- **Tools:** the equipment, technology, software, networks, or other equipment available.
  - **Internal:** Technology immediately available to the teacher and students, including classroom projector, teacher and student laptops, audio recorders and others.
  - **External:** Technology not under direct teacher control, including network, printers, online Moodle learning management system, Internet access points, or other resources externally controlled.

I break down my results and analysis by examining forces internal to the activity system and those acting on it from external sources, specifically identifying those raised by participants through interview, or highlighted by me through observation as either supporting technology integration or working in opposition to it. I then conclude this section with more global statements drawn from my analysis.

Participant Profiles

As I mention in Chapter 3, I sought participants who employed literacy-intensive approaches to instruction, a particular focus of this study, and routinely integrated technology in their classroom instruction, or at least experimented with approaches to using computers in their teaching. In addition to literacy and technology integration backgrounds, these seventh and eighth grade teachers were selected because of their diverse experiences with technology integration and their willingness to participate in this research project. The participants were educators whom I had either known personally through various collective staff endeavors, or whose work with children and computers I had heard about through various district events, conversations with colleagues, or other means.

Wendy is a seventh and eighth grade language arts teacher who had been at Coveside since prior to the start of the laptop initiative. She described herself as a tech-savvy educator who had attended multiple conferences centered on education technology, yet said she still considers herself a learner, often learning from her students. She has mentored other teachers in using educational technology, yet said she is often eager to try out new strategies from the school's technology integrator. Once a week she shared technology tools with her students, and often had students demonstrate innovative websites or strategies like online language translators, video sites or others. In a typical year, her students take on such activities as writing to pen-pals through the postal mail, sharing personal narratives created with video and audio, and extensively reading self-selected titles, then sharing their ideas in online forums.

Julie is a science and math teacher who had been at Coveside for close to 10 years. She described herself as someone who is continually growing at using computers with students, and had taken part in a number of state and regional workshops to help educators improve their technology skills. She was active in state organizations for science and mathematics teachers, and her classroom was one of several model programs the district used to showcase school reform work under way as surrounding districts adopted a similar standards-based initiative. Her students were often engaged in project-based learning activities such as using photography to document the change in the local environment over time, and examining the potential impact of climate change on the state and coastal communities using Google Earth and algebraic equations. Julie described her classroom as a place where students keep track of their own achievement of learning standards, and where her role is more coach than traditional lecture-driven teacher.

Brian, a seventh-and-eight grade science and social studies educator, has been teaching for fewer than five years. He is a steady technology user in his personal life, easily texting, posting to Facebook, and connecting with friends and professional peers from other schools through online networks. He said he left his university teacher education program with little experience in using technology with students. “I really thought I should be using the textbook more, and using the laptops seemed a lot like an extra,” he said. Others on his teaching team did not use the laptops beyond basic word processing, and Brian said it wasn't until he started connecting more with teachers on other teams that he began using technology beyond a basic, replacement stage. His classroom in many respects appeared traditional; pairs of students shared tables facing the front of the class, and most days, their work took place on paper rather than on computer. He said he had increased his use of computers in his fifth year of teaching, but added that an increase in the number of special education students and children with behavioral modification plans had been making that transition challenging.

Tools

Participants said having classroom technology that is easily accessed within the classroom and works without problems is a crucial factor in their decision to use computers and other devices or online services with students. The state program which provided computers to middle school teachers and their students requires that both teachers and students be allowed to bring the computers home for use outside of school as well as during the school day. In addition, teachers are allowed to use their computers during periods when school is not in session, and may utilize the devices for both professional and personal, non-commercial uses. All three participants said that access provided students with the tools needed to work on larger projects offering the possibility to meet multiple learning standards, and gave educators sufficient access to not only plan instruction and assess student learning, but also gain a level of technological comfort by having such pervasive access. The idea that easy access to reliable technology as an influencing factor in the decision to integrate confirms prior research by McGhee & Zucker (2005) reported in Chapter 2; their participants in a Virginia laptop study also name routine access as a critical precursor to the decision to use ICT in education.

Access and Teaching

Wendy described one teaching experience prior to the implementation of the laptop program. The middle school had one computer lab capable of handling 25 students. Because of the limited access, teachers had to book the room weeks ahead of time; some teachers would reserve the facility for several weeks at a stretch, making access a challenge. Wendy said as a responsive teacher who frequently adjusts her plans based on how well her students are learning, the need to commit to lab time so far ahead made incorporating technology a challenging proposition. Wendy explained:

> I don’t plan like that. I have in my mind what I want to do but it’s not concrete … and it might be that things change, what I’m teaching, or how I’m doing it and it

> pushes things back some. So that didn’t work for me, but I tried to get in there as much as I could when it was available.

Julie, another teacher who had been at Coveside before its implementation of the laptop computer program, echoed Wendy's sentiments about the limited access. At times, colleagues would reserve the lab space for multi-week projects, but then the facility would sit unused instead. On other occasions, when she was able to procure computer time, the students' lack of familiarity with technology meant either limiting the computers for students to simply typing papers, or face “spending half the time trying to teach technology, and I wasn't prepared to do that, and that's not what we were trying to learn either,” she said.

Both Wendy and Julie found that inconsistent access made it difficult to incorporate technology into their teaching as a pervasive, evolving approach. As Julie said, “It wasn't even on the radar. I mean, it's not like you could count on it, and the kids couldn't either.” Wendy said that once the school provided computers for all staff and students through the Maine Learning Technology Initiative, after an initial adjustment period it became clear that constant access to technology could significantly change what she and her students could do in the classroom. The change came gradually, and the increased technology did not enter without issues. Server crashes, slow networks, and a lack of familiarity with the computers and the software that came with them all required a new level of resiliency, she said. Wendy explained:

> It was crazy because nobody knew really what these offered. The kids were eager for it and the teachers wanted to use it but there were things that didn’t work, and there were things that we learned as we went, but I’m somebody who, I wing it,

> and I was okay with that because craziness doesn’t affect me as much as others. I just remember a huge learning curve.

Wendy credited the district technology support team with maintaining a network and machines that today, have little down-time and in her experiences, few interruptions.

During observations in her classroom, Wendy's teaching approach included brief periods of direct instruction using her laptop and projector, pointing students to guidelines posted on a whiteboard for access to the latest assignment on Moodle, and instructing students one-on-one as they worked on a nonfiction reading analysis project using model texts accessed online in preparation for developing their own writing. During three observations, the only technical issues encountered in her classroom were solved with a quick phone call to the building's technology integrator. There was no interruption to the class, and the issue went unnoticed by all but a couple of students.

In her interviews, Julie's responses echoed the idea that having near-flawless technology was a critical part of her decision to use computers with students. As she explained:

> It can throw you if you’re right in the middle of something, you know, when the kids are all working on something and then the network goes down, or we can’t print, or Moodle won’t work. That happened last time I tried using GoogleDocs, and right away, it was working again. When it stops working, it can be real challenging, you know, sometimes we’re set up for computers. But it hardly ever doesn’t work. I think if it wasn’t reliable, I’d have second thoughts sometimes, but when you know it works, you forget about that “what if” question because it just works.

Both Julie and Wendy described some of the early days when laptops were introduced to Coveside in 2002 to illustrate the contrast between smoothly working technology, and the absence of such fluidity. When students first began using laptops, access points were not always able to handle the load of students and teachers accessing the Internet, prompting occasional wireless blackouts and students either losing work in progress, or finding themselves unable to access content. Julie explained:

> We were excited to use [the computers], but it didn't seem like it would work, so many people, these computers all trying to get online. And we didn't even really know what we could do with them, I mean, besides research online and write.

Julie said early professional development, largely provided in house, and an understanding that initial days in such an undertaking were bound to have obstacles, created a sense that the program would outgrow its early challenges.

Wendy credited one critical decision made by the district early in the days of the laptop program with the success of the program. That involved locating the district's technical support staff within the middle school, using a third floor suite of offices as their home base for all work in the district. As Wendy explained:

> We've got a fantastic onsite tech team, and having them here to put out fires helped us become stronger earlier on. Now it's OK if the tech team's in another building in the district, because we have enough people here who maybe have enough experience with an issue and know how to work around it.

The consequences of that decision benefited teachers like Brian, who did not have experience teaching prior to the laptop initiative. He named smoothly functioning technology as a near-top influence weighing in his decision to use computers with students. As someone less familiar with ways to include technology in his lessons, he said it was all the more important that he not “get stuck” with technological issues. However, on several occasions, Brian found himself in that situation, and his experience highlights one potential contradiction that may pose a challenge for some teachers' attempts to use technology.

During two observations in Brian's seventh-grade science class, technical problems with Internet access, and a corresponding crash in his course on Moodle, the district's learning management system, resulted in the Tools sector posing a contradiction working against his decision to integrate technology. Brian had repeated difficulties attempting to connect to the Internet while demonstrating a website for students to use in preparation for a lab experiment, eventually forcing him to modify the students' work, scaling down the task and abandoning one of the three learning standards slated as part of the project. On another occasion students experienced problems with the way a program was functioning, and later that same class, problems with Moodle left a number of students uncertain whether much of their work on a project had disappeared.

These incidents demonstrated that such contradictions do not occur in isolation, an early realization I had in this study, and one that prompted and reinforced my decision to use activity theory as the analytical framework. When he was offered the opportunity to review activity triangles coded based on my observation notes, Brian expressed concern about a relatively high incidence of coding for student behavior in opposition to technology integration. His students were in the middle of posting results of their science experiment to a forum in Moodle, the online portal used for some of their conversations. A second part of the assignment, taking place simultaneously, had students developing an analysis of their classmates' results. As students began saving their work, some children posting to their discussion forum early realized that their work was disappearing, rather than appearing on their Moodle page. Several students shut their laptops in anger, another put his head down, others became involved in off-task behaviors, switching to gaming sites and starting to walk around the room and into the hallway. A number appeared to give into immediate defeat. As Brian attempted to troubleshoot the problem, the volume of students grew and behavior worsened. As Brian explained:

> A lot of that, you've got to know, happened when things didn't work, I mean, it wasn't good. We were so far into the project, really to the point where shifting course would have meant abandoning a lot of the kids' work, and when that frustration level builds for some of these kids, that's when you see this. You know, some of them saw this as a moment of success, and then you know, they felt like it was disappearing. So I'm trying to fix things, and you know, when it's looking like we have to give up, they don't understand that sometimes you have to hold on a bit.

Solving the problem was a network-related issue, and after briefly trying to find a way around the glitches, Brian called the school's technology integrator, Sarah. While he directed the students to another activity, Sarah, who had administrative power for the Moodle platform, was able to solve the issue. While some students lost a portion of their work, they were back at the task within 15 minutes, and with some encouraging words from Brian, were again fully engaged.

The issues observed in Brian's classroom were an example where contradictions caused by one segment of the activity triangle, in this case, the Tools sector, sparked contradictions from another zone, the Community sector, and both worked in opposition to attainment of the objective (Figure 7). The insertion of the technology integrator, an external force represented through a separate activity triangle, exerted a positive force on the participant's activity triangle, and in this case, rectified those contradictions. I discuss this role of the technology integrator in more detail throughout this chapter. The role also comes up in Chapter 5 where I discuss implications of my research.

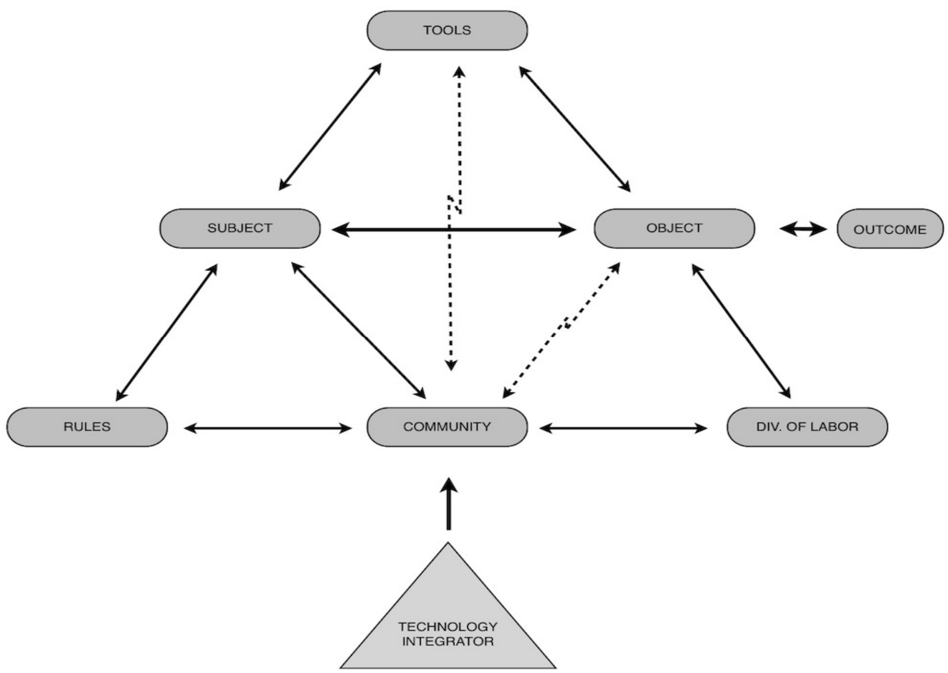

Figure 7. Interaction of contradictions. Observations in Brian's classroom reveal a contradiction caused by technology problems, represented by the dashed line extending from Tools to Community. Those technology issues, resulting from network connection issues, spark negative student behavior issues in the Community sector, resulting in a secondary contradiction working in opposition to the use of technology. The intervention of a technology integration specialist, an external force represented by its own activity triangle, provides a corrective influence. The specialist solves the technical issue, leading to an end of the resulting negative student behaviors acting in opposition to the use of technology, enabling the integration to proceed.

Collaborative Technologies

All three participants use the Internet-based writing program, GoogleDocs, allowing them to share documents electronically with their students, and for their students to create their own documents with each other and their teacher. The collaborative nature of the shared document system also enabled students to share their work across disciplines, allowing them to develop a document as part of a language arts class and then use it as a component of a social science project. Wendy and Julie also said the learning management platform Moodle was a critical component of their classroom practice, both as a place for students to engage in collaborative, threaded discussions, and as a site for them to access teacher-provided resources. Participants said they saw higher student engagement, achievement, and self-efficacy, mirroring findings by Warshauer (2007) and Silvernail and Gritter (2007) which I discuss in Chapter 2. Julie said she routinely created units which incorporated the use of Moodle as a place where students would both obtain access to online instructional components and complete assessments. Brian had been using Moodle for less than a year. He said the portal worked as a "digital classroom" for his students to do some of their work, and also served as a repository for some of the resources he had created to help his students. Brian said he had experimented with several weblog sites, Google's Blogger and the Australian-based Edublogs, but found limitations with each one, particularly a limitation to the degree that he could directly manage student accounts. While Julie and Wendy used GoogleDocs as a routine space for their students to write in, Brian said he hoped the collaborative nature of the system would let him help his students write across multiple disciplines and with multiple teachers. So far, though, he was finding it difficult to develop in-school partnerships with colleagues who would use a similar approach.

Conclusion

The availability and accessibility of classroom technology was considered an essential factor in the participants' decisions to use technology. All three educators said it was important that technology work seamlessly and be readily accessible for both students and teachers. In addition, the availability of laptops outside of the classroom enabled students to embark on long-term projects meeting multiple standards, and gave teachers the tools to plan and respond to student work both during and outside of the school day. Confirming the results of the Henrico County, Virginia, laptop studies by McGhee and Zucker (2005), participants said the ability to use a laptop as a professional tool enabled them to advance skills beyond what they could otherwise, since the freedom to experiment in non-teaching hours, notably weekends and vacations, helped them try approaches that might later become part of their classroom instruction. Julie and Brian both said they used their school-issued computer for professional level, graduate courses. Brian explained: "I have this fuzzy line between what I'm doing as a student, and what I can try with students. Sometimes that boundary, you know, it's permeable. I don't think it'd be that way if this [laptop] stayed at school."

Rules

The Rules segment of the activity triangle includes influences specifically designated as policy, such as a ban on teacher or student software downloads, references to specified curriculum, and directives from building, district, or state-level policymakers.

Those include mandates such as the state policy that students be allowed to take computers home, requirements that teachers use email and shared digital documents to access policies and assignments, and testing requirements that might inhibit the use of or alter the application of classroom technology. This category represents those pressures that a teacher largely cannot control; they signal the structural framework under which the participant operates. Viewed internally, the sector includes references to curriculum, since, while teachers may not have a distinct say in the curriculum itself, they have significant impact on how they address the required standards with students. Thus, that power gives them the opportunity to make decisions regarding whether or not to include technology in its implementation, or whether other approaches might be more suitable.

Externally, I coded for influences or contradictions from building and district-level administrations, including references to funding, policies, evaluation practices, or policies. I had initially expected extensive references in this category to come from faculty meetings; during several years prior to this study, the principal and other staff members had led short technology training sessions during bi-weekly meetings of Coveside teachers. But a change in focus for the administration during the course of the study diminished that avenue as a potential source of influence, since much of the administration's focus went toward a standards-based education reform movement, rather than technology integration, as had been past practice.

Building Administration

Participants said they felt a strongly implied, but generally unstated expectation from their building principal that technology be included in their instruction and their students' learning experience. Building administration was cited by all three participants as one of the most significant influences from the Rules sector. As evidence they cited the visibility of the principal throughout the day with technology tools, a communications approach that relied on digital means, and support for technology-based programs, such as an after-school video club and video-gaming marathon, a fund-raiser for a local charity. Coveside's principal made a recent change in his annual curriculum night address to parents at the start of the school year, just two weeks prior to this study getting under way. Obtaining assistance from the school technology integrator, he filmed his address, screening it on individual monitors through the school-wide cable network while parents and teachers watched from their respective classrooms. His talk focused on the learning experience of students in the coming year, changes in policies, and suggestions for parents to help their children use computers responsibly at home. While he mentioned the term “laptops” more than 11 times in his 15 minute talk and acknowledged that computers were used to help children learn in a variety of content areas, participants said they did not view his address as anything more than informative, largely because he focused on behavioral, rather than instructional, use. As Julie said, “It was nothing we didn't know before.” Much of his talk was aimed more at parents than teachers, encouraging children to adopt responsible computing practices at home to avoid damaging the laptops, using them inappropriately, or online bullying. The presentation, however, did contain a tacit understanding that teachers would be using laptops in their instruction, and that students would need to bring them home to complete a variety of assignments.

Coveside's principal also announced a series of monthly podcasts he planned to create to communicate with the school community. When my study was under way, all three participants said they knew he had released several podcasts, but none had listened to them. All three said they did not have the time to listen to what could be a 45-minute address several times a month, in addition to their regular staff meetings, which were largely led by the principal. Still, my finding confirmed research I refer to in Chapter 2 from Chang, Chin, and Hsu (2008) who found a positive correlation between principals who embraced technology and heightened integration levels by classroom teachers.

Julie said the principal's extensive use and systemic integration of technology in multiple facets of school life created a general understanding that teachers were expected to use computers with students. While she said the district administration held more power to actually increase technology use, the influence from the building level principal was more strongly felt on a day-to-day level than that coming from any other administrative branch. She explained:

> He's your direct boss, really. You know when it's an evaluation, or anything, something your kids are doing, he sees it. Other people don't. So if you're thinking about who can increase computers in the classroom, that's where it happens. He sets the tone.

The principal’s management style frequently took a tone more based on suggestion and encouragement rather than directive, Julie said. She echoed the other participants in suggesting that the complexities of using computers as innovative tools for instruction required a supportive approach. All three participants said policies or approaches that required specific uses of technology for teaching would result in a mechanical compliance that met requirements, but not instructional needs or creative approaches.

Wendy said a decision by the school principal to cease generating teacher evaluations and other documents on paper, opting for digital versions instead, made it clear that technology use was a requirement. Coveside's principal "is definitely a computer geek. He'll be the first one to admit it. He has gone, I believe, totally paperless, so everything in our files . . . I remember at the beginning of the year, he had boxes of the teacher files and that was all scanned and shredded." While Julie and Wendy acknowledged that the shift was beneficial in some respects, and modeled what they viewed as an unstated ideal – extensive technology use – they said the heavy digital approach had its flaws. When their principal made a rapid shift to distributing notices and documents via digital versions only, some of the staff felt lost. Julie explained:

> And so he started posting things on Google Docs and nobody knew they were there. So there was a high frustration level there and even now he's posting things and I have not made the shift to constantly check Google Docs for things like the list of what committee we're on.

But rather than retreat, and reissue documents on paper, Coveside's principal continued with the digital delivery method, and staff members largely got over the frustration and found ways to navigate the new system, Julie said.

Wendy and Brian both said the building-level leadership is the one that holds the most promise for increasing the integration of technology in education. Wendy explained: "If I had to pick one thing, it would be using teachers' meetings to educate teachers on simple and interesting things they can do with the laptops. Teacher education." In prior staff meetings, before the change in district-wide administrative focus toward education reform, bi-weekly staff meetings often began with a 15-to-30 minute demonstration of a technology tool, sometimes led by the technology integration specialist. Wendy added: “I think that has proven to be effective when they have shared things, then more people become comfortable with it and the more comfortable people become, the more they'll step out of that zone and try something else.” Wendy said building leaders were most effective when they provided opportunities for teachers to gain brief introductions to new technology practices, followed by an opportunity to try that approach in a supportive, non-judgmental environment. As a newer member of the profession, Brian said he expected explicit directives from his principal about how to teach, and especially in a 1:1 laptop school, about how computers were to be used. Instead, he said he felt the building principal created an atmosphere in which he sensed he was “open to explore,” to find the best ways that worked for him, his content, and his students. “I'm still doing that,” he said.

Participants said they perceived a definite expectation from building-level administration that technology be employed as an instructional tool, in addition to an administrative one. They said that perception was more based on examples set by the principal, the fact that he routinely used mobile devices to communicate, expressed a preference for digital rather than paper documents, or promoted events focused on computer gaming, digital citizenship, or social networking like Facebook. But each concurred that building administrators could not expect to increase meaningful technology integration through mandate. Brian explained:

> You can force teachers to do a lot of things, approaches, different kinds of strategies like for literacy, you know. But there's a learning curve here, and if [Coveside's principal] said you have to teach with computers, we would, but it

> might just be the same, type a paper or read something. You can't mandate innovation. People just don't work like that.

The report from participants challenges an assertion by Gritter (2007) which I describe in Chapter 2. Gritter, in a study which showed a lower technology integration level among math and science teachers in Maine, suggested mandating integration to ensure all students have exposure to 21st century learning opportunities. But Brian said he viewed building administrators as most effective when they created an atmosphere where teachers could try new approaches, understanding that sometimes, those attempts prove unsuccessful. He suggests the creation of the type of attitude-encouraging, climate-based approach suggested by Warshauer (2004) and Windschitl & Sahl (2002), described in Chapter 2. Brian also said he was more likely to use technology in a new way, or encourage his students to try projects that he had not done before, in such an environment. Brian cited an interactive climate warming chart his students created as one example. Before embarking on the unit, he had no experience with the program his students were using for the project, but said he felt confident that no matter the outcome, his students would learn the content and if the project failed to make it through to completion, the efforts would not be seen as a loss.

The other participants agreed that Coveside's principal plays a key role in creating the environment where technology integration can happen, not by mandate, but by support. Both Wendy and Julie, the two participants with the longer tenure at the school, said a number of concurrent initiatives have left some teachers feeling overwhelmed and reluctant to face new initiatives. Over the six years prior to the start of the study, educators developed a local assessment system to measure student progress – a state-mandated initiative that was later abandoned. Faculty then underwent specialized literacy training and began tracking students' reading and writing achievement. Next, they adopted a new testing regimen to gauge achievement in several subject areas twice a year, a precursor to what some expected would become a component of a student-achievement based teacher evaluation model. Driving technology integration by requirement, rather than through encouragement, would backfire on an administrator, Wendy said. She explained:

> If you force teachers to use technology more than they are, it's just going to be another thing on their plate. We already have to do literacy, and now there's writing. So to have technology put on some people who are not comfortable with it would cause a breaking point.

Julie agreed with Wendy's assessment. She characterized technology integration as different from adopting a new reading program or math template. The vagaries of using technology, the potential for a technical fault to force an end to a project or simply the lack of familiarity of some teachers with programs like those for video creation or mapping scenarios, means that an educator must not only know subject content, but have a sense of fluidity and technical skill to visualize computer-based projects and foresee both teaching strategies and difficulties. Participants' views of the support offered by informal professional development confirms work discussed in Chapter 2 by Glass and Vrasidas (2008) and Levin and Wadamy (2008) who found that professional development through a collaborative peer-teaching model was effective for creating an environment where technology becomes a high-use instructional tool.

District Administration

The Coveside district is led by a superintendent with oversight of the full district and an assistant superintendent with mixed responsibilities including instruction, assessment, and curriculum coordination among other areas. Both report to a locally elected board of education which has ultimate power over fiscal, instructional, and procedural issues. A technology coordinator holds responsibility for all computer technology employed in the district, however his role focuses on providing technical, rather than instructional support. Other than an opening-day teacher workshop presentation from the superintendent, the participants all reported they had no direct contact with district-level administrators during the six-month study period.

Implied Influences

The superintendent opened the 2010-2011 school year by speaking to all educators and staff in the district through a multimedia presentation screened in a large auditorium. Using the interactive presentation platform Prezi, the superintendent illustrated some of the changes occurring in the way children learn and interact today, describing them as "connected both to each other and the world around them," and "always learning." He used the YouTube videos, A Vision of Students Today (http://youtu.be/dGCJ46vyR9o) and A Vision of 21st Century Teachers (http://youtu.be/B4g5M06YyVw) to demonstrate both the changes in students, and the ways in which some teachers have responded to that change through technology intensive teaching. The teacher-focused video opened with the line, "Adapting and evolving, teachers digitally empower diverse learners to connect, communicate, collaborate, in an interactive, technology rich environment." All three participants said they considered the session as more descriptive than directive: the superintendent did not call for teachers to use computers, or issue any mandates for the way instruction should take place. During interviews approximately a month after that superintendent's address, none of the participants referred to the presentation when asked about potential influences from the district-level administration. Still, the superintendent's use of technology has had an impact, as is indicated in quotes I present later in this paragraph. Participants confirm research I discuss in Chapter 2 by Cambre and Hawkes (2004) who suggest that administrative innovations, among other factors, can drive change that makes instructional technology an accepted part of school culture, and of teaching and learning. When prompted about the opening day address, Brian said the superintendent's use of the technology, something that didn't take place without glitches, made him think that maybe he should be doing more to integrate computers. He explained: "He was kind of up there, saying he didn't know if this was going to work or what, and I was thinking that's OK. I guess you can't know if this is always going to work. But it was better than just talking. It's easy to see that as a model." Wendy and Julie both said they did not see that talk as anything that inspired them to further integrate, but, said Julie, “It's what I already do.”

While none of the participants cited direct administrative mandate for technology integration, other than Brian's view of “encouragement” through the superintendent’s modeling, all three said they saw an unspoken expectation from district administration that computers be part of instruction in schools with such heavy investment in technology infrastructure. They viewed that expectation through the sheer financial investment and support for the laptop initiative. Julie said she viewed it as a difficult sign to miss: the district had “put hundreds of thousands of dollars toward this. It's hard not to expect they'd be used.”

Training, Collaboration, Support

Of the three participants, only Julie cited the district level administration as having the most significant external influence in the Rules sector of the activity triangle. She credited district level support for involving the school in the laptop initiative in the first place, as well as providing professional development training that drew educators from throughout the district schools together for multi-week sessions in the summer, led by tech-savvy educators and technology specialists drawn from multiple grade levels. Julie said that training was particularly helpful for science teachers at Coveside, because typically, there were few opportunities available for content-specific educators to share approaches. In district-funded summer technology workshops, she gathered with three colleagues to devise ways that each science teacher in her grade level might use the laptops in similar approaches so that children had a common experience. Using that time, they developed online resource portals, downloadable templates for student work, lab procedures, and tutorials so that students could progress through the curriculum without teachers each repeating the work of their colleagues. Without that time, she said, those conversations wouldn't have taken place, teachers would not be sharing resources, and students would wind up with vastly different experiences.

Indirect Mandates

To some degree, the district administration's influence came indirectly through curricular mandates. District leadership required that Coveside math teachers implement an online mathematics service, the Stanford University's Education Program for Gifted

Youth, which provided e-learning mathematics instruction. During my study, teachers were in the second year of a trial phase of the service, and they had been using the online tutorial and exercise program for approximately 50 percent of the curriculum for all students, supplementing the pre-recorded tutorials with classroom-based instruction. Julie, the only math teacher of the three participants, did not bring up the EPGY program during our interviews when she was asked about administrative influences. She said she hadn't viewed the implementation of the program as a technology influence, though in our conversation, acknowledged that a forced change in curriculum mandating prescribed student computer use effectively did just that.

During one observation of Julie's classes, about half of the students were using the EPGY program while the remaining students worked on paper-based mathematics exercises. Of nine students using the program, two-thirds were actively engaged, working their way through the combined tutorials and exercises as they listened to the recorded lesson through earphones. Of the remaining three students using EPGY, one mechanically clicked through the instructional screens, skipping the tutorials and choosing seemingly random answers to the questions. The other two students had multiple screens open, using an instant messaging program and avoiding the mathematics instruction altogether. The EPGY program self-adjusts to a student's achievement level; a student successfully completing exercises will advance to more challenging concepts. A student doing poorly, or producing inconsistent results, will either remain at the same level or be scaled back to less advanced concepts. Teachers can monitor the EPGY program to see their students' level of achievement, but cannot access real-time data or remotely monitor the students' actions. During a follow-up interview, Julie said she and her colleagues recognized that the EPGY program forced technology integration, but said the program's implementation hadn't struck her as an effort to encourage computer use, but rather to augment her in-person instruction. She also said that the program was on a trial basis, and during my study, she said she hadn't viewed it as a mandate that would likely continue. EPGY was dropped from the Coveside curriculum at the conclusion of the school year for financial reasons and teachers resumed traditional mathematics instructional practices.

State Administration

Under prior district leadership, teachers were routinely provided with forwarded emails and updates sent by the state Department of Education to district leadership. Those communiqués might have included notices about pending funding decisions, updates on certification issues, changes in the state laptop program, or links to research reports funded in part by the Maine Learning Technology Initiative. At the start of this study, it seemed likely that participants would encounter at least several such documents, if not more, and that data would have helped inform their view of influences to integrate technology. But new district leadership ended that practice, and during the study period, that avenue of communication was absent, with no state-level emails or memos either forwarded from the district leadership, or sent directly from state-level sources.

While not necessarily posing a contradiction in the participants' perceptions of technology integration, that absence of communications, particularly between state integration professionals and classroom teachers, failed to produce a potential influence in the Rules sector. None of the participants reported encountering any state-level information regarding technology in education reported in the media, or through any other means.

Curriculum

Curriculum was designated an internal source of influence in the Rules sector because of the potential that participants have to affect either the design of the curriculum, or the way in which it is implemented. While in some respects, as in the district decision to use the EPGY mathematics program, teachers have little initial role in the decision to implement a new curriculum, in most cases, the participants said they are at least consulted before a change is put in force. All three teachers said that curricular influences were among the strongest positive forces in the Rules sector. That may be in part because of the longevity of the laptop program and its presence as a commonplace part of the school environment. Over the decade since the laptop program began, some curriculum items – common assessments and units shared among teachers across multiple teaching teams – now live on a variety of digital spaces accessed routinely from the laptops carried by teachers and students alike. Those resources can be accessed through the use of software or online portals for teachers, students, and even some parents who view their children's academic progress online.

Wendy said the longevity of the program has made computers a necessary tool for students to access the curriculum; during three observations, her students conducted all or most of their classwork using laptops. The students either produced work directly using their own computers, or used them as a means of accessing readings and writing assignments, some shared between multiple content areas. As was often the case, Wendy's students utilized a mix of resources and literacy activities and worked in online spaces, such as Moodle, on collaborative texts through GoogleDocs, or on their own computers using resources accessed through the computer software NoteShare or other in-network means.

Again, while Julie did not directly cite the EPGY program as a direct curricular influence, accessing that component of her students' mathematics instruction would not have been possible without the laptops. She did stress, however, the connection between the extensive technology access and the opportunity for collaboration created through the administration's training opportunities to develop a more cohesive science curriculum. That interplay of access, role of district administration as facilitator, and interchange between colleagues, creates a multi-pronged connection that appears in greater development when I examine the next segment of the activity triangle for these Coveside teachers, that formed by Community.

Conclusion

I examined the role played by the Rules sector defined by influences from or contradictions posed by building, district, or state administrations, as well as the role of curriculum and the rules, operations, or procedures established pertaining to the integration of technology. My review considered curriculum as a player interior to the activity triangle in which the participants operate, and saw administrative influences as exterior factors.

Participants' responses indicate that district level administration can set into play those forces that allow technology integration to take hold; financial provision can be arranged, infrastructure developed, and equipment provided. In addition, administrators and their agents can establish environments where teachers across larger expanses than a single school can share strategies or come to common purposes. But participants reported that it is at the building administrative level where larger policy frameworks can effectively be put into practice in a supportive mode through example, one-on-one interaction with the practitioner, and the creation of strategies, policies, procedures, and practices where teachers can feel free to experiment with different technologies. It is also at this level where direct modeling of desired consequences can take place; for example, an administrator attempting to encourage staff to use technology can increase his or her own technology use in ways that are most visible, and most impact the targeted audience. Participants point not only to their principal's modeling of strong technology use, but also his willingness to design opportunities like faculty meetings where teachers can learn from other teachers in a collaborative atmosphere. They said what made that approach successful was that it did not mandate additional training outside of existing professional obligations, and generally provided tools or strategies that could be put to immediate use in classroom instruction.

Participants also reported that the long-term existence of the laptop program had created a number of natural technology connections to the curriculum. In some ways, they reported, accessing components of the curriculum and building those connections for students was easier through the use of technology, making integration a natural process. That is due in part through the opportunities created through district administrative and building level support for collaborative curricular teams which developed common approaches to content standards and assessments.

Community

The Community sector of the participants' activity triangles included students of the participants and the Coveside school in general, parents – both of the participants' students and community members in general. The sector also included the participants' colleagues – both team members and other teachers, education and technology specialists, and other educators outside of the participants' environs.

Participants reported that they were positively influenced by colleagues who shared approaches using technology and commented on or inquired in a positive manner about the participant's technology integration efforts. Their reporting built on and reinforced the findings I presented in the Rules sector, in which administrative actions provided the support for such interactions to take place. All three participants said they sought out, and drew special inspiration from, other education professionals who found success with integration efforts that resulted in improved teaching and student learning. Brian explained: “It's not just about the tricks, I mean, how to do something. I get impressed when someone can talk about what they did, and what the results were for students. I have to see that.”

External Influences

This study defined external influences in the Community sector as those stemming from teachers, students, and community members not immediately and persistently involved in the participant's teaching team. Each of the participating teachers works on a three-to-four person team, and those teachers share a combined group of students for different content.

Participants cited a number of ways in which they found positive influences from other educators outside of their immediate colleagues. Wendy said she has repeatedly gained administrative approval to attend an annual conference sponsored by the Association of Computer Technology Educators of Maine. Wendy was first invited by the school's technology integrator, Sarah. Wendy explained: “And now it's something that I expect that I'll keep going to because I learned so much and get so many ideas and just come back with some awesome things that I want to use.” Wendy described one session she tries to attend each year, led not by a presenter, but by the classroom teachers that make up the audience. She explained:

> People can go up and share different things that they're doing in their classroom, and I get so much out of that. I just sit with my laptop, just typing in websites one after the other. And I get to see how it can be used, and I get to see an actual teacher who is not an expert using this. So I try to go to sessions that have, that offer a variety of websites or a variety of activities or different ways to be using the laptops.

That opportunity to engage with educators able to model effective technology use provided an experience that Wendy said was difficult to duplicate at Coveside. Her reliance on out-of-school dialog and experiences as effective professional development opportunities confirms research discussed in Chapter 2 (Blin & Munro, 2007; Lim & Hang, 2003; Zhao & Frank, 2003) citing such contacts as influential in supporting systemic integration efforts. Wendy said she works on a team where technology is not heavily used. She said the conference sessions she has attended have prompted her to share what she has learned with a less experienced language arts teacher at Coveside, and

Sarah has asked her to share some integration strategies with colleagues at faculty meetings. Wendy shared one approach for helping students who had been out sick access schoolwork from home, via the Internet and a Moodle site. She explained: “So I showed teachers how to do that, and some of them liked it, but then others just said, 'that's just too much work for me to do.' Well, OK, that's your choice. It works well for me.”

Wendy and Julie both said that other teachers rarely asked about their use of technology, even when their students were creating public, or highly visible, technology-based projects. Both said that even though they viewed Coveside as a school with a collegial atmosphere where teachers frequently interacted, it was uncommon for people to share ideas or strategies. Brian, the newest educator of the three participants, said he sensed a willingness among colleagues to answer questions, but he found few opportunities to query other staff members about effective technology strategies. He explained: “Maybe when it comes to content, curriculum, then it's, 'What's a good thing to do with this topic?' but not a lot more than that.” But all three participants said they found more structured opportunities most effective to learn from colleagues.

Teachers in the Coveside district are required by contract to attend either faculty or department meetings every two weeks. Until the year this study took place, Coveside's faculty had been opening their meetings by sharing a technology tool or strategy that had been effective in classroom instruction. Wendy and Julie both said the approach was effective because the session was part of a pre-scheduled commitment, and its collaborative nature, along with strong support from the school's leadership, helped create an atmosphere of genuine support, rather than criticism. The sessions were originated by the school's leadership, and the technology integrator routinely invited teachers like

Wendy to share some approaches with the staff. Wendy called the sessions one of the most effective professional development tools to integrate technology at the school. She explained: “I think it's proven to be effective because when she [the technology integrator] shares things then more people are comfortable with it, and the more comfortable people become, the more they start using it.” As mentioned in other places in this study, those technology sessions ended as the district shifted priorities to embark on a multi-year project devising a proficiency-based teaching model.

All three participants reported only minor occasions when colleagues, either within their teaching team or outside of it, made suggestions or posed negative comments challenging technology integration, but coding for each participant showed far more frequent positive influences from colleagues.

Role of the Technology Integrator

Coveside's technology integration specialist had been mentioned as a recurring external source, encouraging and supporting the use of technology. The Coveside district has at least one integration specialist in each of its schools, elementary through secondary. Brian and Julie both cited moments when intervention from the technology specialist meant the difference between a successful lesson and a failed one. In addition, Brian said the integrator's role as part instructional coach and part technical advisor meant she was often someone who could offer ideas for teaching content as well as solutions to problems that arose. Both Julie and Brian acknowledged a finding that stemmed from observations in both of their classrooms: the technology integrator was instrumental in solving technical issues that had led to negative actions or dialog from students, essentially counteracting forces that would lead a teacher away from using technology. The role of that specialist quelled student discord and enhanced instruction, as I demonstrated in Figure 7.

Wendy described the specialist as someone who will often prompt a new approach, or offer a technology that might be suitable for a trial run in a selected classroom before being offered on a broader scale to the staff as a whole. She explained:

> I think the top factor here is that we have a technology integrator who comes into our classroom and she's really good at matching. She finds all these different things that people could do and . . . she does a good job at matching the things she learns with teachers who would do well with it. She's patient and available. Like, she'll go into a classroom and she'll teach the first class or two, just part of it, and she hopes that the teacher will take over and teach the next couple of classes on their own, but she's there in the room as a guide . . . she's been in the classroom, she knows it, you know, how it works, but she models it and then steps back. The fact is that she will, she offers that. If something comes up and if you want her to come in your room and share this, whatever it is, a new piece of software, or hardware or program she'll come into your room and share that, show the kids, and then her brain she just goes off with all these different ways that you can use whatever it is that she just came up with.

At times, the participants described the technology specialist partly through personal attributes, mentioning her patience, willingness to support their attempts to try new technology, and her general expertise. But far more often their description focused on the role of the position, rather than the attributes of the person holding the job. They described a professional role that allowed a skilled person, part-technician and part educator, to come in and out of classrooms and demonstrate technology approaches with an understanding of the teaching and learning implications. The participants talked about the advantage of working with an integrator who was not booked with his or her own teaching duties but able to get into other teachers' classrooms. Coveside's technology integrator teaches several classes each day, but has a majority of the day free for consulting and advising teachers, in addition to working on technical issues. The participants also said it was important that the integrator be at ease working with both adults and children, since at times the integrator's effectiveness came through the ability to troubleshoot one child's computer issue while the rest of the class and the teacher proceed with the lesson.

Coding influences of the technology integrator raised some initial issues, since the role and the open schedule that allows for consultation with teachers and numerous other factors are an indirect result of district and building administration policies that provide for such support. But I chose to view the integrator as an external member of the participant's community (Figure 8), reflecting the idea that the effectiveness of this person drew from dual factors: the existence of the position and the approach to the role. The integrator is viewed as external since this person is not an immediate teaching partner or team member of the participant, but rather a general staff member of the school community supported through staffing decisions set through district fiscal and administrative policy. And so that the influence of the integrator be seen best within context of the environment, I viewed it as more critical to include references to the person within the Community sector, since it is that human contribution that was most evident to and most commented on by the participants, rather than the policies that put that person there in the first place.

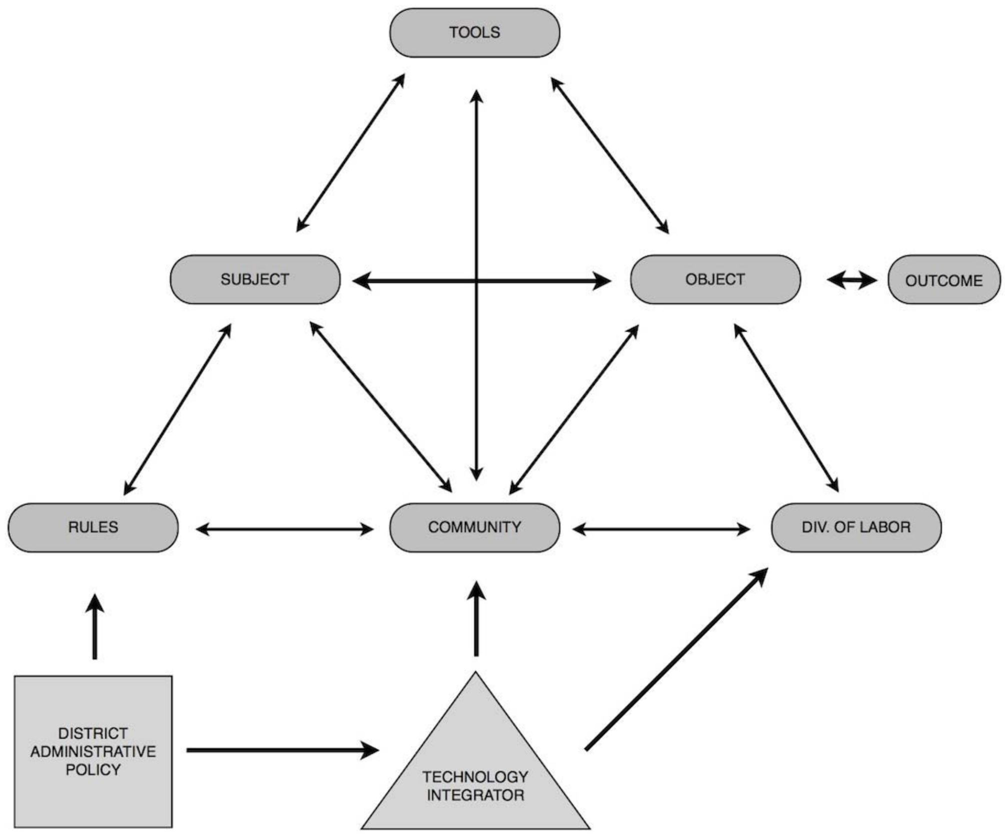

Figure 8: Impact of the technology integrator. Participants cited the involvement of the technology integrator, supported through district administrative policy, as a key external influence driving the Community sector, and enhancing the instructional capability of classroom teachers through the Division of Labor sector. Participants and observations revealed positive influences on student behavior and effectiveness of instruction through involvement of the technology integrator.

While at times the participants complimented the technology integrator Sarah's personality and competence with a variety of technical approaches, they framed those comments in the context of the professional role of the position. That gave the strong sense that the effectiveness, while enhanced by Sarah's personality, was not dependent on it, but rather on the position itself. Still, their description does, however, recommend some qualities and characteristics that might be sought or encouraged in the role, including a strong skill level with a variety of emerging technologies and an ability to examine new technology within an educational paradigm. Participant responses also suggest that the position is one that should be designed with the expectation that the technology integration specialist be an active promoter of technologies, rather than serving as a passive resource. Participants described more than a half dozen occasions when the technology specialist initiated an approach, rather than responded to a request for help. They said that active role made it more likely that educators would try new technology-based strategies rather than seeking them out on their own for possible inclusion in their teaching.

Influences Within the Community

Those included as professional colleagues internal to the participants' activity triangles included teachers on the same team as the participant, or specialists, such as special education aides or others who are directly involved with the team. Participants reported only scant influences from those colleagues with whom they have the closest day-to-day contact. Two of the participants said their interactions with colleagues center mostly on student behavior and team management issues, such as opportunities for shared student time or related issues. One, Julie, said her contacts with her closest teaching partners rarely concern teaching issues or issues like the use of computers. She explained, “We don’t get into how we’re doing things at that level. Maybe it’s because we know we have different styles, and we have different content. Sometimes that's the boundary line," she said. Julie said she rarely has opportunities to talk about teaching approaches with anyone other than her content-area department members, and often, she said, those meetings are booked with administrative matters; conversations about technology are sparse.

Parents

Participants reported only passing influence from parents of their students, citing an occasional query about the way computers were being used. Wendy reported one parent who questioned whether students really needed to bring their computers home each night. She said that concern was more based in the student's social use of the computer for connecting with friends on Facebook and using a video chat feature. While she said she was responsive to that parent's concerns, she did not view that as a complaint about educational technology, but about something out of her and the school's control. Coveside limits access to some social networking sites, as well as others deemed inappropriate, but those blocks do not exist once the student is on a wireless network outside of school. Other parental influences were more classroom focused, rather than policy based.

Wendy said she sensed that some parents were not fully comfortable with the laptops as users themselves, and as a result really didn't know what technology in the classroom was capable of, or what students could be denied when access to technology was limited. Part of that disconnect might result from the school's use of Apple computers and parents' lack of familiarity with the platform, she said. She explained: "They don't know what's on this laptop, and maybe they don't ask their kid what is on there. And we've had parent seminars where they could come in and see, and usually it's the same 10 parents that come every year."

Brian described an incident when he was challenged by a parent who favored more traditional learning styles utilizing pen-and-paper over computers. Brian explained: "He [the parent] wasn't seeing it, using the laptop, and we were doing a simulation. It's not like, well, it's not like it was in his day, and that wasn't coming across." Brian said he made the case to the parent that using the laptop was justifiable, but said the challenge caused him to quickly re-evaluate his approach the next time he assigned his students a similar project. He said he went through the task in his mind, and then continued with his plans for the technology-based project. Brian said he did not consider the challenge a substantial one, serious enough to cause him to reconsider his direction on a deep basis. But the challenge caused him at least a momentary pause in a pedagogical approach he was committed to, and as a result poses a contradiction in the activity triangle, if only a slight one. The connection of parents in these activity triangles – even as either a momentary influence, as in Brian's description, or as a player to be informed of technology's impact, as in Wendy's case, supports research I describe in Chapter 2 by Warschauer, Grant, Del Real, and Rousseau (2004) and Windschitl and Sahl (2002).

Students: Behavior and Dialogue

A persistent force in the integration of technology comes from within the classroom. All three participants noted student actions and dialogue in favor of technology as significant positive influences affecting their decision to use computers. Interview responses were coded to represent positive student actions when participants described moments of heightened student engagement, times when students sought out or initiated learning experiences involving technology, or when student engagement blended with learning experiences to reach new heights in achievement. Signs of heightened student engagement included such characteristics as students expressing enthusiasm for the work, coming in early to work on a project, achieving beyond teacher or assignment expectations, or requesting to take on work similar to an ongoing assignment.

Both Brian and Wendy said there were times when students made suggestions for ways they could use their laptops to create projects or complete assessments. Wendy described an ongoing component of her teaching where she routinely broke from the instructional unit at hand once a week to demonstrate an interesting technology resource or website that might help students improve their literacy, language, research or other skills. Recently, she said, students wanted to share some of that teaching and demonstrate helpful resources they had found on their own. That kind of active interest in computers for learning made her believe that students genuinely wanted to use technology, and confirmed her ideas that students learned better when they could access such tools. The experiences of participants in this study reflects the findings of research by Warschauer, Grant, Del Real, & Rousseau (2004) which I discuss in Chapter 2. Their work identified students as one of a number of influences in driving technology integration, citing expectations as well as behavior as contributing factors.

Negative Student Behavior

Participants also acknowledged that there were times when student behavior, or the perception that students might behave poorly, prompted their decision not to use computers. Brian said he had moments when he was planning a technology-centered project, such as one science research project where he hoped to have students create videos, but then altered the assignment to writing research papers instead because of what he expected would be issues with behavior, largely stemming from just a couple of boys. He also said the process of the interview he was taking part in with me was making him reevaluate some prior decisions. He explained:

> I guess you don't realize it at the time when we make that decision but sometimes when you really think about it the reason you're not using computers is because you have a preconceived idea of what is likely to happen, and that it may not go so well. Though there've been other times when I think about it where the class I thought would do very poorly or would be very distracted was actually not distracted at all but in fact more engaged with computers. So sometimes I think we forget that and maybe use computers as a treat or reward but not really a learning tool. So this is good. This makes me think, this is making me think about what I do sometimes and why.

Brian said that while he usually didn't see student behavior as a driver against using computers, he did recognize that there were times when he thought twice before having students use computers out of fear that there would be a large number of distractions or unproductive behaviors. He said he usually resisted those fears because he had numerous episodes when he found utilizing technology actually more engaging than disruptive. But he described, especially with one class more prone to disruption, several times when he planned units with minimal technology use because of that expectation for negative behavior. The class had several students with identified behavioral issues and special modifications, as well as several students in a special education program with identified instructional needs. Brian said another class, which usually experienced fewer behavior issues, was more likely to use technology “intensively, or at least steadily,” than less well behaved classes. He also said he was more likely to try out new approaches using technology with those students than with classes with a record of more behavior issues.

All three participants reported that the way students talked about using computers was also likely to have an impact on whether they used technology or not, again, confirming prior research. While Wendy reported that she was buoyed by students who routinely would ask if they were using computers, Brian and Julie both said they tended to find it more noticeable when students complained about technology. Julie said while her students are generally happy to work with computers, “when it's new, or they know it's going to be some real hard work, they're like, 'Do we have to get our laptops out?' But if they think it'll be easy, or they're going to listen to music, or they think they can play on something, then it's good, you know, they're all happy.” While Julie said she did not routinely adjust her teaching based on the responses of her students, she said there are occasional times when student reaction plays a role. Wendy reported that she typically overlooks students' complaints about technology. She explained: “They can be immature. They whine a lot. They complain a lot about having to do work. They want it to be simple, easy, get it done.” She said that usually her students' complaints aren’t really about using computers, but more commonly are focused on the fact that they are assigned work to complete.

During observations in both Brian's and Julie's classrooms, each experienced student responses against technology use, but neither teacher ceased its use. The student complaints stemmed at least in part from technical issues the classes were experiencing with network or program issues outside of the control of the participant teacher. Julie's students were finding challenges with an online science program used as a tutorial; during a previous class, students following directions did not obtain the expected results, and they began complaining when Julie announced they would need to repeat some work to determine whether they should continue using the program. Brian ran into similar complaints, and experienced multiple disruptions from students when another online learning platform, Moodle, underwent a technical problem that cost some students their work and like the experience of Julie's students, forced some to repeat previously completed assessments. Julie abandoned her program after her students experienced similar problems while repeating their work; Brian, with help from the technology integrator, was able to maintain his direction in spite of the student opposition.

Conclusion

Student behavior can impact whether or not a teacher uses technology; participants reported that they were less likely to use technology with students who were behaving negatively than with children who responded positively to computer use. That came even with the acknowledgement that using technology often helped teachers create more engaging, stimulating learning experiences that usually kept students focused on the learning activity rather than promoting distracting behavior. Participants also said they were buoyed by student enthusiasm, expressed either verbally or through engagement, for technology use; they reported that the more engaged students were, the more likely technology would continue to be involved, and conversely, less engaged students were less likely to see technology incorporated into their lessons. During observations of two classrooms, disruptive behavior stemmed in part from technology problems that forced students to repeat work they had already completed, but in only one did that behavior lead to the teacher ending the use of technology. In the other case, the intervention of the technology integrator solved the technical issue, resulting in a turn in student behavior and successful instruction.

Participants said one of the driving forces for their use of technology came from being able to access and learn from other educators who used technology in their instruction. One of the three participants said she finds access to other educators through attendance at conferences outside the district, meeting teachers from other parts of the country with novel ideas. That connection to out-of-district resources comes through an involvement by the school's technology integration specialist whom all three participants cite as a key figure in their use of technology. All participants credited the specialist for a series of teacher-led mini-workshops demonstrating various integration strategies during pre-scheduled faculty meetings. They reported that the ability to access colleagues in such an informal, supportive setting helped them see the strategies as accessible and connected them with other practitioners attempting to meet similar goals with students through the use of technology.

The technology integration specialist weighs as a key figure because of her ability, in part through design of the position, to interact with both students and teachers around a variety of content, and for a mix of purposes. Two of the three participants pointed to her ability to solve technical issues – or access outside resources that would provide that solution, almost as soon as the need arose, in turn preventing a disengagement of students from the learning process. All three participants said the technology integration specialist's ability to help find resources, suggest integration strategies, and arrange for opportunities to experiment with approaches made it much more likely that they would use technology with students than had she not be able to provide such services.

Division of Labor

The Division of Labor sector of the activity triangle focused on participants' perceptions of how well technology either enhanced their role as a classroom teacher, or made their instructional work less effective. All codes for this sector were internal to the activity system since I looked at what was taking place within the classroom, and the ways in which participants talked about their personal involvement with technology and their role as instructor. While clearly external influences can impact a teacher's job in a variety of ways, I have accounted for those forces by examining multiple other sources in the other activity triangle sectors.

Each participant indicated strong connection between their decision to use technology and the ease of access to instructional material or increased teaching effectiveness they saw when employing its use. Interview transcripts coded for instructional effectiveness aided by technology surpassed all other sources for influences within the classroom. That measure was supported during observations, where commonly, technology integration efforts resulted in students smoothly accessing assignments or learning materials, at times with far greater speed and complexity than they could have without computers. Of course, contradictions emerged in this category as previously discussed, where technology problems challenged efforts at instruction or even ended it completely until a solution was developed or a secondary approach attempted.

In one of Wendy's classes, students were using their laptops to listen to narratives recorded through StoryCorps, a national nonprofit initiative. Each student had to access several stories, listen to the recording, follow along by reading the accompanying text on their screen and then define several characteristics about what they heard. They used that exercise as a preparation for writing and producing their own narratives, an element of the state learning standards that Wendy's students were expanding into a digital media project. During the work, students' eyes were focused on their screens, breaking only occasionally to share an idea or ask a question of another student. Otherwise they remained on the texts they had selected and used their computers to start drafting their own. During a follow-up interview, Wendy said that her students would have been much more distracted had the project not been computer based. She explained:

> I help them channel their distraction, that energy into something that is going to be productive, and really, they couldn’t even do what they're doing without these computers. It wouldn't be the same, you know. It wouldn't mean what this will when they're all done.

The day before, Wendy’s students had been working with the school librarian learning to search an electronic database that would enable them to search for authors and texts based on similarities to other writers whose work they had already experienced.

Wendy said she had some doubts that students would be able to read for sustained periods on their laptop screens; she said she was concerned that students would lose focus and begin diverting their attention to other websites. A website designed to prevent distractions and increase reading worked to keep her students focused on the text, however. She said it was that kind of technology use that reaffirmed her decision to continue using computers in an intensive manner. She explained: “I was wondering if I was making the right decision, but they could do it. They were sticking with it.”

Julie said her teaching practice had become more focused, and her students' ability to access information more streamlined, because of the prevalence of technology at Coveside. She explained:

> Right now they can get to my Moodle page, see the assignment, download all the resources and get going. I'm not handing out paper or passing things around, and some of them aren't even waiting. They just go ahead. If they get lost, or some thing doesn’t work, then we're in trouble. But that's not usually it, you know. It's much, much easier.

During one observation in Julie's classroom, her students used Moodle and PortaPortal, an online bookmarking site, to access several different resources being used for a mathematics unit. In an interview, Julie said she would have to maintain a counter of files just to provide the resources for her students that she can instead provide with the “digital file cabinet” that she maintains on Moodle. She explained: “It’s all right there. When a student completes a lesson, they can move right ahead. There’s no waiting. And if they don’t get something right off and I’m not available or they’re at home, they can see what I’m trying to teach them and take off on their own.”

Brian described science classes where students could, but didn't have to, wait for natural processes to study. They could plant real seeds in real dirt, yet watch the growth take place in an online lab the following day, watching the virtual growth of plants through a full cycle even before their real seeds had the opportunity to germinate. Like Julie's classroom, the walls in Brian's room, amidst the posters supporting classroom content, also contained procedural charts for accessing Moodle or other online repositories where he had posted resources and assignments for the students. They still needed him for directions, guidance, and feedback, but could access content and direct themselves to some degree.

All three participants presented classrooms where students could move faster and learn more with technology immersive environments than without. Wendy said that the teaching that takes place in her classroom is much richer with technology, and that remains a continuing factor in her decisions to use computers. Wendy explained: “It's just how we do it now. It's how I live, and it's how these kids live.”

Conclusion

Participants said they were more likely to teach with technology when its use made their instruction more effective. They described moments when students found increased opportunity to access information of varying levels of complexity from diverse sources, or to create learning products that could not have been made otherwise. They said technology offered them opportunities to make learning more accessible for students, and provide students with avenues to direct their own progress, to a degree. Participants' descriptions of their students' learning was supported by observations that showed students engaged in technology-intensive classrooms where in part they were able to manage their own learning and take on roles and responsibilities not otherwise obtainable without technology.

As in other categories, participants pointed to involvement from the technology integration specialist and her active role in coaching and supporting educators as they experimented with different technologies. They noted multiple times when her suggestions either helped improve their instruction, or solved critical problems that challenged the learning process for students. In several observations, I was able to confirm the importance of the technology integration specialist in either solving technical issues that thwarted student achievement, problems unsolvable by a classroom teacher during an instructional period, or in providing resources such as online tutorials or other instructional models that helped teachers extend their ability to connect students with learning standards.

Summary of Findings

This study was aimed at understanding teacher perceptions of influences driving technology integration and contradictions slowing or thwarting its use. Through the analysis of data gathered from the triangulation of interview, observation, and document, I offer insights that hold opportunities for education systems to shape policy and create cultures where educators are supported in attempts to use technology in a transformative manner.

Participants suggest that a culture of innovative teaching and meaningful learning with computers can be created by administrators who not only model technology use, but build and nurture opportunities where educators can gain confidence with tools and techniques in casual settings that are already part of the teaching day. Their views support a vision of effective professional development as an integral part of the existing day-to-day interactions of teachers - the development of a community of learners. For those educators who desire more intensive opportunities to learn innovative practices, participants also suggest that non-compulsory access to a larger community of educators needs to be made available to help connect practitioners to colleagues outside their school environment. Participants stressed that while some professional development can be mandatory, in a sense like that offered at a faculty meeting already part of the working day, exposure to new approaches works best when done in a casual manner presented by colleagues, administrators, or through voluntary participation in external communities.

One of the most effective approaches for building technology integration lies in the support developed through a readily accessible specialist able to offer innovative pedagogical approaches with technical expertise. All three participants said their school's technology integration specialist was instrumental in their use of non-traditional approaches. Some said the specialist bridged the gap between traditional classroom teaching and innovative techniques and approaches. Others said the specialist's capability, through availability and skill, to offer ideas for teaching or troubleshoot technical issues helped them succeed while teaching with technology. They especially pointed to the role that the specialist played during critical moments that not only solved technical issues, but as a result helped build environmental situations where learning could take place. They also cited the technology integration specialist as a key link to training and experiences outside of the immediate school environment where they could connect with other educators from different backgrounds and bring new ideas back to share at their own school.

Finally, participants were most likely to use technology when they could see a direct connection to enhanced teaching and learning. Factors like accessibility of curricular components, student behavior and engagement, and levels of student achievement all helped support technology integration. Conversely, teachers reported that they were more likely to shift to traditional modes of teaching when student behavior eroded, technical problems arose that could not easily be solved, or a clear connection to enhanced instruction did not exist. I discuss implications from these findings, limitations of this study, and recommendations for further research in Chapter 5.

CHAPTER 5: IMPLICATIONS AND LIMITATIONS

A growing number of schools worldwide are embarking on programs like that developed a decade ago in the state of Maine in which students are provided full-time access to a computing device. While numerous variations exist on the design of such programs, from 24-hour, seven-day per-week access, to school-use only, computers and personal technology devices are an increasing part of the education landscape. But the presence of these devices does not guarantee their use, in either a traditional sense, replacing hand-writing an essay for word processing, for example, or in a transformational mode: using a computer to create a "paper" that incorporates audio, video, even animated type to engage an audience a hemisphere away.

I began this study in part because I saw both variants in the divergent world of my own children's experience - computers as play in school, and as transformative technology, creating new modes of learning. I was curious what lay behind an educator's decision to use technology with students, particularly in a setting like a Maine middle school where every teacher and student has full-time access to a laptop computer, and nearly round-the-clock access to the Internet. I wondered what drove some teachers to make technology an essential component of their instruction, and why some educators at least periodically made the decision not to employ computers. My study viewed this decision through teachers' perceptions of the various influences that come within and outside their classroom, and through an activity theory analysis I am able to offer several insights into these decisions.

The results of my study suggest that key administrative decisions may provide essential infrastructure and support leading to an increased use of technology by educators with the potential for that use to reach a transformative level, where the educational achievement of students takes on characteristics that could not exist without the use of technology. Participants also provide insights into why they have chosen not to use technology at times, but instead to revert to traditional methods of teacher-directed instruction. Those ideas provide additional direction that might support the success of 1:1 computer programs in schools.

Using analysis of the data, this chapter offers three categories of implications with particular relevance for systemic perspectives of technology implementation programs: staffing and support, professional development opportunities, and classroom instruction. I follow these implications with a discussion of the limitations of this study, and recommendations for further research.

Implications for Staffing and Support

Participants reported that both technical and pedagogical support was critical in using computers in a transformative or innovative manner. They said that when the 1:1 laptop program was first implemented, having support on site was essential to trouble-shoot basic connectivity issues, network access problems, or glitches in using programs or equipment. In the program's infancy, classroom educators at the school where this study took place had a limited knowledge both of the capabilities of the equipment and software they had been provided, as well as the potential for educational uses. What came to be seen as easily solvable problems several years into the program were issues that could bring instructional technology use to a halt. But as staff members became more proficient and confident in solving some of the recurring, basic problems on their own, the need for that steady, immediate support lessened, especially as educators found themselves in a burgeoning community of practice where collaboratively, they developed the skills to diagnose and solve most simple technical problems. As the need for technical support waned, what grew in its stead, according to participants, was an ongoing need for pedagogical support. They found that combination of technical and pedagogical assistance through a building-based technology integration specialist. Participants cited that position as critical in the ability of educators to develop innovative technology approaches that allowed students to learn in a constructivist environment where they could develop connections between the content and the resulting assessment products or opportunities that gave their learning an experiential tone.

The integration specialist was critical for participants in several regards. As an information source, she was able to offer teaching tools and approaches, or assessment opportunities that participants said they would not have known existed otherwise. Software such as GoogleEarth, scientific simulations, or techniques for making video or audio podcasts helped participants transform their instruction and their students' learning; a unit about plant growth did not end with a quiz, but rather an analysis of why a “virtual” seed grew into a deformed or otherwise healthy plant, depending on the environmental conditions a student could create in an online, digital lab. Participants said the specialist's ability to either instruct a full group of educators, or coach a teacher and students during a working class made the role indispensable. Likewise, they also said her ability to troubleshoot technical matters, often at a moment's notice, helped them keep students learning, and prevented issues that might be easily rectified from bringing a class to a full halt, either through increased student frustration or inaccessible resources.

Participants suggested that what made the technology integration specialist especially effective was that combination of technical and pedagogical knowledge, combined with a professional schedule that provided the specialist with ample time to assist in classrooms, work independently with teachers, and continuously explore resources and technologies to aid teachers in creating meaningful learning experiences for their students. The ability of the specialist to also help educators build connections to outside communities of learning, and to assist administrators in devising in-house professional development using a model that valued the experiences of classroom educators and their students, was also deemed critical to the success of the position. I discuss the role of the technology integration specialist in more detail through upcoming sections.

Implications for Professional Development

Several different approaches for professional development were successful in helping educators develop and implement transformative uses for technology; participants cited the importance of options to connect with professionals outside of their school environment, as well as opportunities to learn from colleagues during casual, supported sessions that were part of their existing performance as professionals. Data supports results from Glass and Vrasidas (2008) who found professional development grew naturally in education cultures that fostered “communities of practice” where teachers bond through common activity developing informal partnerships and collaborative mentorships. Participants stressed the importance of the informal professional development that could evolve among colleagues. The conversational, nonjudgmental demonstration style offered a freedom among those sharing their practice; they were not seen as pedantic, nor were they in a position where they were seen as pedagogical role models with the accompanying pressure such a position would carry.

As discussed in the previous section, the role of the technology integration specialist proved critical to the success of such a collaborative professional development model as that developed at Coveside. That position provides a connection among educators willing to experiment with innovative, constructivist approaches and share that work with colleagues in a friendly, professional setting. In some respects, the role also serves as a bridge between educators and administrators; the fact that the specialist is a colleague inviting colleagues to share, rather than an administrator appointing teachers as presenters develops professional connections through a peer-collaboration rather than supervisor-employee model.

While citing the ineffectiveness of either mandated technology use, contrary to recommendations by Gritter (2007) discussed in Chapter 2, or mandated professional development in settings that prolong the teaching day, participants reported that they valued extended opportunities to improve their skills - both technical and instructional - through professional development outside of their schools. Again, they found the influence of the technology integration specialist helpful in identifying relevant opportunities outside of the school district. The specialist was also seen as instrumental in developing in-district opportunities such as summer workshops for extensive experimentation and curriculum development work with instructional technology. Participants said they were positively influenced to use technology either through professional learning opportunities with educators outside of their teaching community, or through extended voluntary workshops where they could explore various strategies and delve deeply into connections between technology applications and their own curriculum.

Implications for Instruction

Participants reported they are more likely to use technology when a direct connection to improved teaching and learning is evident. Approaches or software that either lets students create visible solutions to problems, understand concepts through means including visual, aural, or virtual, or that enable them to learn at individualized paces were seen as positive influences reinforcing the integration of technology. They said they were disinclined to incorporate computers when technical issues posed a block to learning either directly, or by leading to an atmosphere creating disengaged students and associated disruptive behaviors. Their reports confirmed previous research by McGhee and Zucker (2005) and Harris and Smith (2004) linking technology use by teachers with positive student behavior. Again, the implications for instruction connect back to the technology integration specialist through both field observations and participant reports that a capable resource skilled in both technology and pedagogy can prove essential in enabling teachers to access quality instructional tools and prevent the technical disruptions that can lead to disengaged learners and negative student behavior.

Part of the discussion about perceptions of instructional benefits connects to the tools and approaches employed by teachers. One participant acknowledged a disassociation with mandated approaches, such as a recorded, online tutorial for mathematics instruction, but instead held a strong commitment toward teacher-created instructional tools that directly served the needs of students accessing the curriculum. All three participants found creative uses for Moodle, the open source learning management system hosted on the district's server and maintained by the technology integration specialist. Moodle is often used for online learning, but for the participants, it served as an easily accessible digital space helpful as a repository for learning resources like videos, websites, documents, or other media, and as a work area for student products, conversations, and assessments. They cited the ease of access, teacher-control of the site, and potential for interactivity at a variety of levels among instructor and learner within the professional, non-commercial space.

Beyond Moodle and the use of digital tools for conversation or assessment, participants said they were heavily influenced to use technology when they found transformative experiences for their students - those tasks, products, or assessments that could not take place without the use of technology. They cited such things as interactive, multimedia writing blending audio, music, words, and images to convey narratives, the creation of websites, weblogs, or other digital publications that could present ideas, and experiences like virtual labs or global field trips that could not otherwise take place within a school environment. Participants said experiences like these connected instruction, curriculum, and learner, making technology an ideal tool for effective teaching. When experiences such as these helped students reach curricular goals, participants said they were more likely to not only continue their use, but seek out additional avenues for technology-connected teaching and learning.

The participants' ideas about the link between technology and instruction again connect to the position of technology integration specialist, since throughout this study it has been that person consistently able to either directly provide instructional resources and approaches, or set up structures in which those tools could be obtained. As part technical guide and part instructional coach, it is that position which, depending of course on the personal traits of the person in that role, could most directly impact the integration of technology in classroom instruction.

Limitations

Several important factors limit this study, including the number of participants, ongoing labor and reform issues at Coveside, location, as well as researcher-centered issues.

The study is restricted by the small number of participants. I chose three participants for logistical reasons; the short duration of this study, as well as limited resources made it impractical to extend the size of this research project. A greater number of participants would have held the potential for broader diversity in responses and potentially might have shed light on some factors not disclosed in this study.

Another limitation centers on a contract renegotiation dispute between the Coveside educators' union and the district. As I disclose in Chapter 3, educators had been in their second year without a new contract when I began this study. Anticipated salary increases had been stalled pending resolution of the issue, and contractual language regarding seniority, tenure, and professional duties were in dispute, creating tensions between some teachers and administration. However, since active negotiations were still going on at that stage, those involved were seeing progress toward an amicable resolution. I did not ask whether any of the participants were members of the union, and the dispute did not come up in any of our conversations. But the fact that such a dispute holds a personal impact, the delay of anticipated pay increases as well as potential shifts in job security, evaluation, and duties, raises the possibility of participant bias. That possibility may be especially worth noting because I ask participants about their administrators, both building and district-level; a negotiation dispute potentially sets administrators and participants at odds.

The district's ongoing reform of the instructional system toward a proficiency-based model poses another potential limitation as reflected by the refusal of one prospective participant to take part in this study because of the perceived workload of implementing structural changes to the teaching practice. The realignment of the district leadership's priorities holds some impact on the practices of the participant teachers, and the exposure they had to other forces, evidenced in my discussion both here and in

Chapter 4. It is difficult to know what other changes to factors influencing my question may have resulted from this change in focus for the district.

As I acknowledge in Chapter 3, the study is also limited by the use of a single researcher and the potential for bias, as well as the use of a single research location. Ideally, a study would involve not only a larger number of participants, but also multiple researchers who at the analytical end, at least, might provide interpretations that could elude a single researcher. Multiple study sites would increase the potential for a greater diversity of the overall participant pool as well as a broader range of experiences. My study at Coveside essentially looks at a collection of activity triangles for three participants; when that number of participants is increased and locations diversified, the potential for new sources of influence and contradiction, or the chances for confirmation or rebuttal of my findings, increases correspondingly.

Recommendations for Further Study

My research takes place at one middle school in a rural Maine community. However, the fact that a statewide laptop integration program exists in Maine offers the potential for an inquiry on a broader scale, including an examination beyond just middle-school grades to include influences on perceptions of secondary educators as well.

One participant in my study acknowledged challenges in using technology with some student populations, notably those with identified behavioral issues. Additional studies could expand current research on the integration of technology with these students, especially when portable devices or immersive technologies offering a persistent connectivity are present.

Finally, the results of my study point to the importance of the technology integration specialist as a key player in developing transformative uses of technology for teaching and learning. Further studies should explore the attributes of this role in more detail, particularly identifying those traits and conditions that make this position an effective one. Activity theory may again offer both conceptual and analytical frameworks to examine this role within the context of the teaching and learning system.

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APPENDICES

APPENDIX A

INFORMED CONSENT

You are invited to join a research project conducted by David C. Boardman. He is a doctoral student in the College of Education at the University of Maine. Dr. Richard Kent is the faculty advisor. The purpose is to learn why teachers use computers.

What Will You Be Asked to Do?

You will be asked to take part in two or more interviews. Each session will be recorded and transcribed. The researcher will ask about 25 questions in each session. Each session may last 90 minutes. The researcher will ask to observe you teach on three or more days.

Risks

The time may be inconvenient.

The presence of an observer may be distracting.

Benefits:

This study will not benefit you. This research may help program leaders understand issues facing teachers.

This study may help you see issues in your decision to use technology.

Compensation:

You will not be paid.

Confidentiality

Your name will not appear on any documents. Data will be kept in the investigator's locked office and on his private computer. The faculty advisors, Dr. Richard Kent and Dr. Susan Bennett-Armistead, may have access to the data. Your name will not be released. All data will be destroyed when the report is complete.

Voluntary

This study is voluntary. You may refuse any questions. You may refuse access at any time.

Contact Information

If you have any questions, please call the researcher at 207-649-9863. You may also contact him at 48 Lakeview Drive, Oakland ME 04963. You may email him at david.boardman@maine.edu.

You may reach the faculty advisor, Dr. Richard Kent, at 207-581-2746. You may reach him by mail at 317 Shibles Hall, University of Maine, Orono, ME, 04469-5766. You may email him at rich.kent@maine.edu.

If you have any questions about your rights, please contact Gayle Jones, Assistant to the University of Maine's Protection of Human Subjects Review Board. Her phone number is 581-1498. You may email her at gayle.jones@umit.maine.edu.

Signing below indicates that you have read and understand the above information. You will receive a copy of this form.

____	__________________
Signature	Date

APPENDIX B

INTERVIEW QUESTIONS

The purpose of this interview is to understand educators' perceptions of influences to integrate technology. Once background data is gathered, questions are arranged by three overarching themes.

- Background questions
    - How long have you been teaching?
    - How long have you been at Coveside Middle School?
    - What grade do you teach?
    - How many students do you work with?
    - How long have you worked in a 1:1 environment?
    - How would you rate your technology skills?
    - Do you read the school's Twitter feed? If so, how often?
    - In the course of a day, what percentage of your students will use computers for their class work?
    - Do you use Moodle or another online portal to either house class materials or as an environment for children to work in?
    - Please describe the ways in which students use technology in your classroom.
    - How would you describe the environment at Coveside in terms of the use of technology?

    - Could you describe how technology, specifically the 1:1 computing environment, has changed the way learning takes place in your classroom?

- How do perceptions of expectations and pressures of community stakeholders (students, parents, community members) influence the degree to which you integrate educational technology?
    - Do you believe the parents of your students expect you will use computers in your classroom instruction?
    - Do you believe parents expect their children will need computers for homework or other longer projects?
    - Do you believe parents expect their children's education will be different with 1:1 computing than it would be otherwise?
    - Do you believe community members – taxpayers, local business members, and residents – expect children must use their laptops in order to succeed in school?
    - Do you believe community members – taxpayers, local business members, and residents – expect children's education will be different with 1:1 computing than it would be otherwise?
    - Could you describe a time when a student has talked with you about using computers more or less frequently?
    - Could you describe a time when a student has asked to use computers in a certain way, or to use technology in a different way than planned?

  - Could you describe a time when you observed a student using personal or school technology and then modified your integration of technology as a result of that observation?

- How do perceptions of expectations and pressures of colleagues influence the degree to which you integrate educational technology?
  - Do colleagues influence the way you use computers with children in school?
  - Can you describe a time when a colleague shared a technique or application for using computers in the classroom?
  - How do your colleagues view the use of computers in education?
  - How do you think colleagues view the way you use technology with students?
  - Have other teachers ever encouraged you to use computers with students or discouraged you from using technology?
  - Do you and your colleagues share applications for teaching with technology, i.e. applications, programs, projects?
  - Can you describe a time when your observation of a colleague's technology use or decision not to use technology influenced your own decisions to integrate computers in your teaching?

- How do perceptions of district and school-level administrative initiatives, policy directives and influences affect the integration of technology?

- Do you believe district leaders – superintendents, assistant superintendents, school board members, expect that you are using technology with students?
- Do you believe your building leadership has a position one way or another on whether or not you use computers with students?
- Do actions or words from your building leadership – principal and assistant principal – encourage or discourage you from using technology in your classroom?
- How do perceptions of state-level initiatives, policy directives and influences affect the integration of educational technology?
- Are you ever copied on emails from the Maine Commissioner of Education to district superintendents or other recipients?
- Do you receive email directly from the Maine Learning Technology Initiative?
- Are you aware of any studies by the Maine Learning technology Initiative or other state agencies relating to the use of technology in education/

APPENDIX C

OBSERVATION PROTOCOL

Observations will be conducted three times in the classrooms of participant teachers following introductory interviews. The observations will take place during the hours of 8 a.m. and 12 p.m. due to researcher scheduling issues and to coincide with the participants' teaching schedules. Observations will take place during pre-arranged windows to avoid conflicts with periods dedicated to testing or other special situations.

The focus of my observations will be to examine those influences emanating from within the classroom that may bear on teacher perceptions. In addition, I will be looking for:

- Resources and evidence of their use by teachers and students. Resources may include computers, software, presence and use of personal teacher technology, presence of use of personal student technology, peripheral devices (projectors, storage media, recording devices, interactive whiteboards, etc.)

- Posted and established procedures and their presence in the classroom, specifically classroom technology-linked rules, schedule, presence of the curriculum and other existence of requirements or protocols which either encourage or prevent technology integration

- Teacher / Student Interaction - Student questions, evidence of students to either independently solve technology-linked issues, collaboratively solve them, or seek/require teacher assistance; evidence of teacher's ability to solve problems, respond to student issues. My observations of students will be limited to a global view of students in the classroom, rather than specific observations of individual students.

Observation Questions:

Is the instructional technology a critical component for instruction? Is instruction made more clear, more effective, because of technology use? Or is instruction more difficult because of technology (i.e. less clear, indirect, ineffective)?

Evidence: Students engaged with laptops 50 percent or more of a class period; use of collaborative tools: GoogleDocs, Moodle, Noteshare; use of wikis/weblogs, other technology, use of instructional tools.

Code:

ISTRUC-instrpos: component of instructional role aided by technology use

ISTRUC-instrneg: component of instructional role hindered by technology use

Do students encourage technology use?

Evidence: Expressions of engagement or enthusiasm for computer use or technology-based assignments, visible engagement while working with technology, verbal support for technology use.

Code:

ICOM-actpos: student action demonstrating support for technology integration

ICOM-diapos: student dialogue expressing support for technology integration

Do students discourage technology use?

Evidence: Expressions of disengagement or resistance for computer use or technology-based projects; this may include on-or-off task behaviors: inattention, talking to peers or teacher on non-instructional topics, signs of overall disengagement, or direct verbalization opposing technology use.

Code:

ICOM-actneg: student action opposing technology integration

ICOM-dianeg: student dialogue opposing technology integration

Do students use their own technology laptops, iPods, phones, digital recorders, tablets, etc. Or, is classroom technology available and in use either by teacher or students?

Evidence: Student, teacher use of personal or instructional technology devices as part of classroom learning.

Code:

ITOOLS-techpos: classroom-based technology infrastructure in support of integration

Are there technical difficulties in using technology?

Evidence: Observations of websites not functioning, network problems, computer or program malfunctions.

Code:

ITOOLS-techneg: classroom-based technology infrastructure in opposition to integration

APPENDIX D

INTERVIEW CODES

INTERNAL

INTERNAL COMMUNITY (ICOM):

ICOM-coldiapos: colleague dialogue expressing support for technology integration

ICOM-coldianeg: colleague dialogue opposing technology integration

ICOM-colactpos: colleague action demonstrating support for technology integration

ICOM-colactneg: colleague action opposing technology integration

ICOM-parpos: parent/community support for technology integration

ICOM-parneg: parent/community opposition for technology integration

ICOM-actpos: student action demonstrating support for technology integration

ICOM-actneg: student action opposing technology integration

ICOM-diapos: student dialogue expressing support for technology integration

ICOM-dianeg: student dialogue opposing technology integration

INTERNAL STRUCTURE (ISTRUC):

ISTRUC-rulespos: rule, policy in support of technology use

ISTRUC-rulesneg: rule, policy in opposition to technology use

ISTRUC-instrpos: component of instructional role aided by technology use

ISTRUC-instrneg: component of instructional role hindered by technology use

ISTRUC-currpos: curricular effectiveness improved through technology use

ISTRUC-currneg: curricular effectiveness lessened through technology use

INTERNAL TOOLS (ITOOLS):

ITOOLS-techpos: classroom-based technology infrastructure in support of integration

ITOOLS-techneg: classroom-based technology infrastructure in opposition to integration

EXTERNAL

EXTERNAL COMMUNITY (ECOM):

ECOM-colldiapos: colleague dialogue expressing support for technology integration

ECOM-colldianeg: colleague dialogue opposing technology integration

ECOM-collactpos: colleague action demonstrating support for technology integration

ECOM-collactneg: colleague action opposing technology integration

ECOM-parpos: parent/community support for technology integration

ECOM-parneg: parent/community opposition for technology integration

ECOM-actpos: student action demonstrating support for technology integration

ECOM-actneg: student action opposing technology integration

ECOM-diapos: student dialogue expressing support for technology integration

ECOM-dianeg: student dialogue opposing technology integration

EXTERNAL STRUCTURE (ESTRUC):

ESTRUC-rulespos: rule or policy in support of technology use

ESTRUC-rulesneg: rule or policy in opposition to technology use

ESTRUC-bladpos- building-level administrative support of technology use

ESTRUC-bladneg- building-level administrative opposition to technology use

ESTRUC-disadpos- district-level support of technology use

ESTRUC-disadneg- district-level opposition to technology use

ESTRUC-stadpos- state-level administrative support of technology use

ESTRUC-stadneg- state-level administrative opposition to technology use

EXTERNAL TOOLS (ETOOLS):

ETOOLS-techpos: technology infrastructure in support of integration

ETOOLS-techneg: technology infrastructure issue in opposition to integration

APPENDIX E

OBSERVATION CODES

These codes are INTERNAL: INTERNAL codes represent influences observable within the direct learning environment comprised of the classroom, teacher, students, and any other influences within that atmosphere.

INTERNAL TOOLS (ITOOLS):

ITOOLS-techpos: classroom-based technology infrastructure in support of integration

ITOOLS-techneg: classroom-based technology infrastructure in opposition to integration

INTERNAL STRUCTURE (ISTRUC):

ISTRUC-instpos: component of instructional role aided by technology use

ISTRUC-instneg: component of instructional role hindered by technology use

ISTRUC-instrpos: instructional effectiveness improved through technology use

ISTRUC-instrneg: instructional effectiveness lessened through technology use

INTERNAL COMMUNITY (ICOM):

ICOM-actpos: student action demonstrating support for technology integration

ICOM-actneg: student action opposing technology integration

ICOM-diapos: student dialogue expressing support for technology integration

ICOM-dianeg: student dialogue opposing technology integration

ICOM-parpos: parent/community support for technology integration

ICOM-parneg: parent/community opposition for technology integration

APPENDIX F

CODING DICTIONARY

Master Code: INTERNAL COMMUNITY (ICOM) This master code reflects influences internal to the activity system stemming from or related to members of the community under study, including teachers, staff, students, and parents.

ICOM-coldiapos – This sub-code references colleague dialogue expressing support for technology integration.

ICOM-coldianeg – This sub-code references colleague dialogue opposing technology integration.

ICOM-colactpos – This sub-code references colleague action demonstrating support for technology integration.

ICOM-colactneg – This sub-code references colleague action opposing technology integration.

ICOM-parpos – This sub-code references parent/community indications of support for technology integration.

ICOM-parneg – This sub-code references parent/community indications of opposition for technology integration.

ICOM-actpos – This sub-code references student action demonstrating support for technology integration.

ICOM-actneg – This sub-code references student action demonstrating opposition for technology integration.

ICOM-diapos – This sub-code references student dialogue expressing support for technology integration.

ICOM-dianeg – This sub-code references student dialogue opposing technology integration.

Master Code: INTERNAL STRUCTURE (ISTRUC) – This master code reflects influences internal to the activity system stemming from or related to the structure of the learning community under study. Structure includes references to rules, prescribed curriculum and learning standards, and other components of the system under direct influence by teachers or other actors within the system.

ISTRUC-rulespos – This sub-code references rules policies in support of technology use.

ISTRUC-rulesneg – This sub-code references rules and policies in opposition to technology use.

ISTRUC-instrpos – This sub-code references components of instructional roles aided by technology use.

ISTRUC-instrneg – This sub-code references components of instructional roles hindered by technology use.

ISTRUC-currpos – This sub-code references curricular effectiveness improved through technology use.

ISTRUC-currneg – This sub-code references curricular effectiveness decreased through technology use.

Master Code: INTERNAL TOOLS (ITOOLS) – This master code reflects influences internal to the activity system stemming from or related to the technology tools or software available to the learning community under study.

ITOOLS-techpos – This sub-code references classroom-based technology infrastructure in support of integration.

ITOOLS-techneg – This sub-code references classroom-based technology infrastructure in opposition to integration.

EXTERNAL

Master Code: EXTERNAL COMMUNITY (ICOM) – This master code reflects influences external to the activity system from teachers, staff, students, and parents or community members not directly connected to the teacher, classroom or learning community under study.

ECOM-colldiapos – This sub-code references colleague dialogue expressing support for technology integration.

ECOM-colldianeg – This sub-code references colleague dialogue opposing technology integration.

ECOM-collactpos – This sub-code references colleague action demonstrating support for technology integration.

ECOM-collactneg – This sub-code references colleague action opposing technology integration.

ECOM-parpos – This sub-code references parent/community support for technology integration.

ECOM-parneg – This sub-code references parent/community opposition for technology integration.

ECOM-actpos – This sub-code references student action demonstrating support for technology integration.

ECOM-actneg – This sub-code references student action opposing technology integration.

ECOM-diapos – This sub-code references student dialogue expressing support for technology integration.

ECOM-dianeg – This sub-code references student dialogue opposing technology integration.

Master Code: EXTERNAL STRUCTURE (ESTRUC) – This master code reflects influences external to the activity system stemming from or related to the structure of the learning community under study. Structure includes references to rules, prescribed curriculum and learning standards, and other components of the system not directly influenced by teachers or other actors within the system.

ESTRUC-rulespos – This sub-code references rules or policies in support of technology use.

ESTRUC-rulesneg – This sub-code references rules or policies in opposition to technology use.

ESTRUC-bladpos – This sub-code references building-level administrative support of technology use.

ESTRUC-bladneg – This sub-code references building-level administrative opposition to technology use.

ESTRUC-disadpos – This sub-code references district-level support of technology use.

ESTRUC-disadneg – This sub-code references district-level opposition to technology use.

ESTRUC-stadpos – This sub-code references state-level administrative support of technology use.

ESTRUC-stadneg – This sub-code references state-level administrative opposition to technology use.

Master Code: EXTERNAL TOOLS (ETOOLS) – This master code reflects influences external to the activity system stemming from or related to the technology tools or software available to the learning community under study.

ETOOLS-techpos – This sub-code references technology infrastructure in support of integration.

ETOOLS-techneg – This sub-code references technology infrastructure limits in opposition to integration.

APPENDIX G

COVESIDE LAPTOP POLICY

COVESIDE SCHOOL DISTRICT

File: IJNDB-R

STUDENT COMPUTER AND INTERNET USE RULES

These rules accompany Board policy IJNDB (Student Computer and Internet Use). Each student is responsible for his/her actions and activities involving School Unit computers, networks and Internet services, and for his/her computer files, passwords and accounts. These rules provide general guidance concerning the use of the School Unit's computers and examples of prohibited uses. The rules do not attempt to describe every possible prohibited activity by students. Students, parents and school staff who have questions about whether a particular activity is prohibited are encouraged to contact a building administrator or the Technology Coordinator.

Students are not permitted to utilize privately-owned computers at school.

A. Consequences for Violation of Computer Use Policy and Rules

Student use of computers, school networks and Internet services is a privilege, not a right. Compliance with the School Unit's policies and rules concerning computer use is mandatory.

Students who violate these policies and rules will be subject to disciplinary and/or legal action and may have their computer privileges limited, suspended or revoked. The building principal shall have the final authority to decide whether a student's privileges will be limited, suspended or revoked based upon the circumstances of the particular case, the student's prior disciplinary record and any other pertinent factors.

B. Acceptable Use

The School Unit's computers, networks and Internet services are provided for educational purposes and research consistent with the School Unit's educational mission, curriculum and instructional goals.

All Board policies, school rules and expectations concerning student conduct and communications apply when students are using computers. Students are also expected to comply with all specific instructions from teachers and other school staff or volunteers when using the computers on school grounds.

C. Prohibited Uses

Examples of unacceptable uses of computers on school grounds that are expressly prohibited include, but are not limited to, the following:

1. Accessing Inappropriate Materials - Accessing, submitting, posting, publishing, forwarding, downloading, scanning or displaying defamatory, abusive, obscene, vulgar, sexually explicit, sexually suggestive, threatening, discriminatory, harassing and/or illegal materials.

2. Illegal Activities - Using computers, networks and Internet services for any illegal activity or in violation of any Board policy or school rules. The School Unit assumes no

responsibility for illegal activities of students while using computers on school grounds.

3. Violating Copyrights – Copying, downloading or sharing any type of copyrighted materials (including music or films) without the owner's permission (see Board policy/procedure EGAD – Copyright Compliance). The School Unit assumes no responsibility for copyright violations by students.

4. Copying Software - Copying or downloading software without the express authorization of the Superintendent or his/her designee. Unauthorized copying of software is illegal and may subject the copier to substantial civil and criminal penalties. The School Unit assumes no responsibility for illegal software copying by students.

5. Plagiarism - Representing as one's own work any materials obtained on the Internet (such as term papers, articles, music, etc). When Internet sources are used in student work, the author, publisher and web site must be identified.

6. Non-School-Related Uses - Using the School Unit's computers, networks and Internet services for non-school-related purposes such as private financial gain; commercial, advertising or solicitation purposes; or any other personal use not connected with the educational program or assignments.

7. Misuse of Passwords/Unauthorized Access - Sharing passwords, using other users' passwords, and accessing or using other users' accounts.

8. Malicious Use/Vandalism - Any malicious use, disruption or harm to the School Unit's

computers, networks and Internet services, including but not limited to hacking activities and creation/uploading of computer viruses.

9. Unauthorized Access to Blogs/Social Networking Sites, Etc. - Accessing blogs, social networking sites, etc. without specific authorization from the supervising teacher.

D. No Expectation of Privacy

Computers remain under the control, custody and supervision of the School Unit at all times. Students have no expectation of privacy in their use of school computers, including e-mail, stored files and Internet access logs.

E. Compensation for Losses, Costs and/or Damages

The student and his/her parents are responsible for compensating the School Unit for any losses, costs or damages incurred by the School Unit for violations of Board policies and school rules while the student is using School Unit computers, including the cost of investigating such violations. The School Unit assumes no responsibility for any unauthorized charges or costs incurred by a student while using School Unit computers.

F. Student Security

A student is not allowed to reveal his/her full name, address, telephone number, social security number or other personal information on the Internet. Students should never agree to meet people they have contacted through the Internet without parental permission. Students should inform their teacher if they access information or messages that are dangerous, inappropriate or make them uncomfortable in any way.

G.. System Security

The security of the School Unit's computers, networks and Internet services is a high priority.

Any student who identifies a security problem must notify his/her teacher immediately. The student shall not demonstrate the problem to others or access unauthorized material. Any user who attempts to breach system security, causes a breach of system security or fails to report a system security problem shall be subject to disciplinary and/or legal action in addition to having his/her computer privileges limited, suspended or revoked.

H. Additional Rules for Laptops Issued to Students

1. Laptops are loaned to students as an educational tool and are only authorized for educational purposes.

2. Before a laptop is issued to a student, the student and his/her parent must sign the school's acknowledgment form. Parents are encouraged to attend an informational meeting before a laptop will be issued to their child.

3. Students are responsible for the proper care of laptops at all times, whether on or off school property, including costs associated with repairing or replacing the laptop. (Coveside School District) offers an insurance program for parents to cover replacement costs and/or repair costs for damages not covered by the laptop warranty. Parents who choose not to purchase insurance should be aware that they are responsible for any costs associated with loss, theft or damage to a laptop issued to their child.

4. If a laptop is lost or stolen, this must be reported to a school administrator immediately. If a laptop is stolen, a report should also be made to the local police immediately.

5. The Board's policy and rules concerning computer and Internet use apply to use of laptops at any time or place, on or off school property. Students are responsible for obeying any additional rules concerning care of laptops issued by school staff.

6. Violation of policies or rules governing the use of computers, or any careless use of a laptop may result in a student's laptop being confiscated and/or a student only being allowed to use the laptop under the direct supervision of school staff. The student will also be subject to disciplinary action for any violations of Board policies or school rules.

7. Laptops must be returned in acceptable working order at the end of the school year or whenever requested by school staff.

8. In addition to the foregoing rules, the following rules apply to parents when laptops are brought home from school:

a. Parents will be informed of their child's login password. Parents are responsible for supervising use of the laptop and Internet access when in use at home.

b. Parents will receive a specific user ID and password for the sole purpose of accessing resources available through the MLTI parent link. No other personal use of the laptop by parents is permitted.

BIOGRAPHY OF THE AUTHOR

David C. Boardman has spent much of his career in education examining how students learn with technology. He was born in Meriden, Connecticut, in 1964 and graduated from Cathedral High School in Springfield, Massachusetts. He was awarded a Bachelor of Arts in Journalistic Studies and Political Science from the University of Massachusetts at Amherst in 1987. Boardman worked as journalist for a variety of daily and weekly publications before starting a career in teaching in 2002. He was awarded a Master of Education in Literacy Education in 2005 from the University of Maine. He has taught students in English language arts, journalism, and multimedia communications at high schools in central Maine, and around the world through online courses he developed. He is an adjunct instructor in literacy at the University of Maine and has presented at conferences throughout the United Stated on literacy, technology, and student engagement. His work has been published in the Journal of Maine Education, and by Heinemann and the National Writing Project. He is a candidate for the Doctor of Education degree in Literacy Education from the University of Maine in May, 2012.