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Building a Culture of Innovation: A Case Study in Digital Integration

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By

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Abstract

This case study dissertation examines the implementation of digital technology in a mid-sized public school district in southern Minnesota. The methodology involved unstructured interviews and close observation of several teachers, administrators and related staff in the junior-senior high building. These observations were presented in informative vignettes that help to tell the story of the culture of innovation in this school, as well as highlight some of the implementation strategies that aid this school and district in meeting its goal to meet all learners in a 21st century society. The study identifies common barriers such as staff resistance, funding, and technology equity among students, as well as identifying some positive strategies that have met these challenges in an effective way. The resulting information paints the picture of a district that uses digital technology to build an innovative culture.

Key Words: Leadership, Systems, Innovation, Culture, Technology

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Table of Contents

Chapter I

Introduction

"We are living in exponential times" (Fisch, 2007).

"Honey...I think the world is flat." (Friedman, (2006, p.5).

Background of the Problem

Much has been written during this first decade of the 21st century about the swiftness and relative power that new technologies have wielded in our society. Since the mid-1990's, the planet has been wired and connected in ways only dreamed of in the days of Jules Verne and H.G. Wells. What started as a relatively experimental and novel program written by Tim Berners-Lee, and built upon a military systems-connection structure, the World Wide Web has revolutionized most every component of our lives (Shadbolt & Lee, 2008). The emergence of the Internet and the devices which followed to harness this power, have had a profound impact on long-standing systems like public education. As Fisch (2007) explains, we are living in *exponential times.* In other words, we are living at a time when technology is changing at rates measured as exponential, not by standard growth indices. The impact on an institution like public education has created great change. The wisdom and worthiness of these changes continues to be debated, but the fact remains that new technology is changing our world, and its impact on how American public education functions is worthy of study.

It is with this lens that this study is conducted. As a teacher in public school, it is easy to see how some of these changes are implemented, how some evolve, and how some penetrate the school culture despite great efforts to stifle them. The purpose here is not to explore ways that technology aids instruction, planning, or other aspects of the

business of teaching youth. The purpose here is to explore the barriers and problems related to the timely and effective implementation, training, and use of technology, and to see how they can be mitigated.

One major shift in technology at this time is the change from boxed software applications and licenses to Internet-based applications which provide products and services to individuals and institutions delivered and stored on the Internet. These may be collectively referred to as "web 2.0" or "cloud-computing" applications. These two terms, coined only recently, are sometimes used interchangeably, though there are technical differences between the two. The other greatest difference is the addition of the element of user-creation and collaboration. Albion (2008) states that:

> In recent years, new, less traditional uses have emerged for the web. Most of these are characterized by opportunities for the large number of those who would be consumers in the traditional model to contribute content to the web. The forms of content that can be contributed directly into web sites include text (blogs and wikis), images (Flickr and similar sites), audio (podcasts) and video (YouTube). In addition to these there are services that allow users to participate in various group activities and to complete, individually or collaboratively, a variety of tasks such as document creation and editing that would previously have relied upon software on a local computer. (p. 4)

Another major shift in technology is the mobilization of the personal computer. Laptop computers, tablet computers such as Apple iPads, and mobile phones bring new opportunities for digital integration to public schools.

This study will focus on how one school district successfully overcomes many barriers to digital technology integration, and how they are leading in digital integration by overcoming these barriers and creating a culture of innovation.

Statement of the Problem

The problem, as observed by several researchers as well as most lay educators and administrators, is that as a new technology shift becomes evident and widely acknowledged within mainstream society, educators often face many barriers in discovering, testing, evaluating, and ultimately adopting or implementing the new technology. Beggs (2000), in a study of higher education professionals, isolated an abundance of factors which create barriers to the use of new technology: lack of support staff, desire to retain traditional methods, and ease of learning and use. Likewise, public schools face many of the same barriers. As public education endeavors to deliver tools and skills that students may use to become successful in life and society, the responsibility for the school institution to remain current and applicable to the mainstream society is undeniable. Finding the causes of implementation barriers or slowdowns can be beneficial in schools' future organizational aptitude and ability to evolve positively.

One of the most notable problems schools face as they endeavor to innovate or to implement digital technology is human resistance. Scott McLeod (2010), in one of his many criticisms of the school system's reluctance to move forward with technology, offered the following:

> Can anyone else think of an employment sector other than K-12 and post-secondary education where employees have the right to refuse to use technology?

> For example, a grocery store checker doesn't get to say 'No thanks, I don't think I'll use a register.' A stockbroker doesn't get to say, 'No thanks, I don't think I'll use a computer.' An architect doesn't get to say, 'No thanks, I don't think I'll use AutoCAD.' But in education, we plead and implore and incentivize but we never seem to require. In many industries, knowledge of relevant technologies is a necessary prerequisite for either getting or keeping one's job. Sometimes the organization provides training; sometimes the employee is expected to get it on her own. Either way the expectation is that use of relevant technologies is a core condition of employment. Why aren't our school organizations expecting more of their employees? (2010)

Certainly, McLeod and others have hit upon a major challenge to innovation and digital technology in schools. Human resistance to using digital technology is difficult to pinpoint, but anecdotal examples abound with regular frequency. Bingimlas (2009) outlined several reasons for educators' resistance to technology innovation. Among these are lack of time, lack of effective training, lack of access to current technology, and lack of technical support. He went on to argue that only through effective peer collaboration can the barriers creating resistance to change be addressed. Kezar (2001) provided a bit more understanding to the question of resistance to change. She suggested that part of the resistance is the conceptualization of the type of change desired. She argued that change should be accurately described by the type of change desired: diffusion, institutionalization, adaptation, innovation, and/or reform (p.19). While diffusion and institutionalization focus on changing people, adaptation, innovation, and reform begin to treat the problem of resistance and change as an organizational effort.

Mayya (2007) suggested that resistance is a complex problem due to many factors such as leadership, planning, and training (p. 2). Butler and Sellbom (2002) outlined similar issues with integrating technology, adding that in some cases, faculty are willing to learn and institute technology if it can be made clear that the technology will be highly reliable. Breakdowns of equipment were a large concern in their findings.

When schools bridge these barriers and resistance factors, such as the district in this case, it is relevant to identify the methods, strategies, and policies that contributed to the smooth integration of digital technology.

Purpose of the Study

The purpose of the study is to identify factors that have aided the timely and effective implementation of instructional digital tools and services by faculty and administrators in this district, particularly in the secondary building. The intention will be to uncover areas in which this district is finding success, as measured by any of several indicators, in implementing or utilizing digital technology in instruction. Research will be presented in a series of anecdotes describing successes and strategies observed in this school district.

Primary Research Questions

1. What are the strategies and/or norms that allow for this school district to evolve swiftly and appropriately in regard to digital technology in instruction and education?
2. What systemic changes promoted a greater acceptance of new digital techniques among faculty and administration?

3. What digital uses or strategies are showing the most success or promise in this school district?

4. What barriers were present in this case that impeded the innovation of new digital technologies, strategies, or philosophies?

5. What does the district in this case do differently to overcome said barriers?

Assumptions and Biases

The researcher in this case is a seasoned public school classroom teacher and frequent user of digital technology. I had previously visited some of the schools in the case study district on several occasions, and I was familiar with some of the staff and administration, particularly the high school building principal before beginning. As a connected educator and frequent education technology user, I began the observations in this case with some specific personal assumptions and biases:

1. All school districts have at the least a basic desire to implement technology in some way. That is to say that it is assumed that no district desires to fall behind, and no district is actively attempting to stop the district from implementing any technology.

2. The strategies, successes and problems described by the staff surveyed in the study reflect a reasonable level of overall accuracy.

3. Most, if not all, districts desire a high level of technology use and instruction in their schools, but find integration difficult.

4. Successes in effective technology innovation and integration could be observed in achievement data, teacher enthusiasm, anecdotal success stories, and student engagement.

5. Barriers often include human resistance to change, despite an understanding of the positive outcomes that may result.

Importance of the Study

The inherent importance of the study is its relevance to the field of education because technology changes swiftly – this is a fact that cannot be refuted. The greater challenge, however, is for large institutions like education to keep pace in a reasonable manner. There is a relative scarcity of research on the actual process of technological shifts in K-12 education, particularly in relation to recent changes to Internet-based applications and systems. This is a growing and ever-changing field of study, and teachers, administrators and education researchers will require as much information as available in order to make reasonable and effective choices in leading their students, faculties, districts, and the profession itself into the 21st Century.

Definitions of Relevant Terminology

Application (computer). For the purposes of this study, an application can refer to any computer program that allows users to perform a function or task, or which allows the computer or device itself to carry out tasks unto itself. Microsoft Word, Adobe Photoshop, and Apple iTunes are common applications.

Cloud computing. Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. (Mell & Grance, 2010, p.1).

Flipped classroom. General term for instruction based in digital media lessons that become the homework for students, allowing the class time to used for exploration and practice, instead of lecture.

Google apps. Google's suite of online-based applications which are offered largely free of charge for general use. They include electronic mail, a calendar program, word-processing, and data management programs, as well as website and weblog (Blog). Many schools use a version known as "Google Apps for Education."

Hardware. **"**Computer hardware typically consists chiefly of electronic devices (CPU, memory, display) with some electromechanical parts (keyboard, printer, disk drives, tape drives, loudspeakers) for input, output, and storage, though completely non-electronic (mechanical, electromechanical, hydraulic, biological) computers have also been conceived of and built." (Technology Dictionary, 2012).

Software. "The instructions executed by a computer, as opposed to the physical device on which they run (the "hardware"). Software can be split into two main types - system software and application software or application programs. System software is any software required to support the production or execution of application programs but which is not specific to any particular application" (Technology Dictionary, 2012).

SMART board. An interactive whiteboard developed and sold by SMART Technologies, Inc., which allows for on-screen and keyboard functions of a computer to be accessed through a large touch-screen.

Web 2.0. Coined by Bill O'Reilly in 2007, this term refers to largely user-created websites which are collaborative in nature, and which feature content heavily produced

and managed by users. Some of the most common examples are Wikipedia, YouTube, and eBay.

Wiki. "A collaborative web site comprised of the perpetual collective work of many authors. Similar to a web log in structure and logic, a wiki allows anyone, using a web browser, to edit, delete or modify content that has been placed on the web site including the work of other authors" (Technology Dictionary 2012).

Delimitations

In identifying the scope and purpose of this study, I was particularly interested in how the challenges of implementing technology in school settings happened in actuality. As such, I did not have an interest in pursuing any of the broad pedagogical rationales and criticisms of technology itself. I did consider the concept of schools using technology as a benefit, but had no intention of delving into the greater philosophical implications and justifications of what and what does not make for good school technology. I am also deliberately refusing to make investigations or negative value judgments pertaining to individual faculty aptitudes regarding the implementation of technology. In order to create a warm, open environment in which to collect qualitative data, subjects needed to know they were not being scrutinized individually. A specific distinction needed to be made to define the difference between gathering data on the results of training and the evaluation of any person's individual skill, effort, or responsiveness in anything more than the most generic manner.

Chapter II

Review of Literature

The research in this study focuses on the selected school district's system and how the schools within it incorporate digital technology and 21st century skills into their curriculum, planning, instruction, and administration. This chapter provides an overview of current literature relating to the research questions and concepts germane to the case of this school district. The primary research questions this study addresses are:

1. What are the strategies and/or norms that allow for this school district to evolve swiftly and appropriately in regard to digital technology in instruction and education?
2. What systemic changes promoted a greater acceptance of new digital techniques among faculty and administration?
3. What digital uses or strategies are showing the most success or promise in this school district?
4. What barriers were present in this case that impeded the innovation of new digital technologies, strategies, or philosophies?
5. What does the district in this case do differently to overcome said barriers?

Digital Technology in Public Schools

For the past several decades, the implementation of digital technology in k-12 education has been widely researched and debated. The late 20th century brought an increased urgency to schools and the use of technology. Mobilized by the bleak picture painted by the Reagan commission report, *A Nation at Risk* (1983), American educators searched in several directions for strategies and models that would stave off the "risk" the

report publicized. One of the most promising was to integrate technology into school curriculum. By 2002, the landmark law known as No Child Left Behind (NCLB) outlined specific goals related to the integration of digital technology in public schools. In part, the law identified goals for technology integration in education to bridge the various socio-economic and learning disparities seen nationwide, and to create a learning environment that better reflects the 21st century workforce. (Learning Point Associates, 2007)

While schools scrambled to assemble effective technology, there remained clear problems. (Cuban, Kirkpatrick, & Peck 2001; Bauer & Kenton 2005) and others suggested that while technology enthusiasm was great in general, there was little evidence to prove it was being used effectively. Cuban (2002), in his seminal work, *Oversold and Underused: Computers in the Classroom*, pointed out a great discrepancy between the promise of technology in schools and its actual fruition. He found most schools' use of technology was limited to word processing and Internet searches (p. 178), adding that teachers at that time had largely only used technology to do tasks they had already been used to doing, such as keeping grades and writing lessons (p. 179).

Later research suggests recent initiatives are having more positive results, though many initiatives in motion today are the result of research that occurred in the late 1990's and early 2000's. Dockstader (1999) pointed out that "discrete computer skills take on new meaning when they are integrated within the curriculum...organizing the goals of curriculum and technology into a coordinated, harmonious whole" (p. 73). The idea of technology integration has evolved from the more simplistic early concept of providing access to computers in schools. Culp (2003) observed that American schools are "improving both their technological capacity and their readiness and ability to use

technology to foster the learning of core content and the development of students' skills as communicators, researchers, and critical consumers of an ever-expanding world of information" (p. 2). Similarly, Kotrlik (2009) found that teachers in general had widespread access to computers, projectors, and audio-visual equipment (p. 56). The Information Sharing Environment (ISE) Report to Congress (2009) indicated widespread successes in implementing new technologies in schools, citing high numbers (97%) of teachers having computers in the classroom, and high rates of internet access and computer access in school overall. Also included in this report are indications that teachers and administrators use computers in education work such as grading, attendance, and other administrative tasks at a high percentage. While this report points out positive successes in computer technology being embraced in schools, it does not make mention of the level of educational benefit from the use of these technology (p. 1).

The May 2011 State Educational Technology Directors Association (SEDTA) National Education Technology Trends Report (Jones, Fox, & Levin, D. 2011) highlighted myriad positive initiatives to illustrate how the implementation of technology is producing academic gains and positive results in classrooms and schools across the nation. The report's executive summary stated that:

> States in partnership with school districts all over the country continue to lead in transforming Pre K-12 education to meet the challenges and goals of the 21st century. State-level approaches, led by state educational technology directors, include identifying and developing innovations that effectively advance program goals; scaling up those innovations that prove to be effective across districts and states; coordinating educational technology investments with other state and

federal funds; and ensuring that district investments are productive and effective. (p. 2)

What this report seems to suggest is that since the 2009 United States Department of Education (ISE) report was compiled, some gains have been made in the areas of technology use in instruction. The data in this report is more anecdotal than quantitative, but discusses whole-state initiatives such as South Carolina's Competitive District Program, *Tie it All Together* (a 1:1laptop initiative), Wisconsin's Digital Literacy 2.0 Project, and Tennessee's e4TN and e4000 Online Learning Initiative (Jones, Fox & Levin, 2011, pp. 14-16), each of which detail a statewide program to increase the use and effectiveness of digital instruction beyond that of word processing and grade management. Similar programs are highlighted for each state, and similar promising data are presented to form the picture of a nation fully committed to increasing the effective use of digital technology.

The Digital Divide

While some integration obstacles may be improving, there still remain crucial issues hindering the successful integration of digital technology in schools. Hohlfeld, Ritzhaupt, Barron, & Kemker (2008) and Clotfelter, Ladd & Vigdor (2008) both found an increasing schism between computer and technology access and use in lower socio-economic status schools compared with their more affluent counterparts. Hohlfield et al. (2008) described this so-called digital divide in three levels. The first refers to the "equitable access to hardware, software, the Internet, and technology support within schools" (p. 3). The second level of the digital divide refers to "how frequently students and teachers use technology within the classroom and the purpose for which the

technology is being used" (p. 3). The third level regards the user knowledge necessary to use technology to improve one's own life (p. 3). The authors went on to explain that this aspect is perhaps the most difficult to render, as it is closely linked to the previous two levels. Without adequate experience working within the first two levels of this model, students struggle to achieve adequacy or aptitude in the third. (p. 3) These three areas can become an effective framework in which to make a case study in one school. The Hohlfield, et. al. (2008) study outlined disparities between high socio-economic status schools (high SES) and low socio-economic status (SES) schools. "Students in high SES schools, at every level, appear to be using production software significantly more frequently than in lower SES schools" (p.13). Not surprisingly, the remedy Hohlfield, et. al. suggested to address the inequities of the digital divide, SES notwithstanding, are consistent with those outlined by current 21st century learning models. In addition to the divide described by Hohfield et. al. is the problem of computer access, especially to high speed Internet. Crawford (2011) explains,

> While we still talk about "the" Internet, we increasingly have two separate access marketplaces: high-speed wired and second-class wireless. High-speed access is a superhighway for those who can afford it, while racial minorities and poorer and rural Americans must make do with a bike path. (p. 1)

Forbes blogger Gary Marks (2011) drew much criticism in December 2011 for a post titled "If I Were a Poor Black Kid" in which he outlined the advantages of technology in overcoming poverty and marginalization. He claims that technology is generally widely available to all children regardless of background and that this technology could be used by any child to become an excellent student.

Settles (2012) disputed this claim, siding with Crawford (2011) by explaining that it isn't only the access to the money needed to pay for high-speed Internet, but also the fact that it simply isn't there. In Philadelphia, Settles remarks, the service providers simply do not reach many poor neighborhoods. "Philadelphia isn't the only urban city facing this dilemma," she says. "I've spoken with providers in other cities who have documented similar issues." (p. 2) Moderres (2011) wrote that the "divide" can be better described as "digital differentiation" (p. 6). She agreed that there is a problem with access to technology (or bandwidth) in lower socio-economic demographics, but also cited greater usage within these groups of mobile phones for browsing. It is unclear to Moderres whether the usage of mobile devices adequately accounts for less access to networked computers, but she posits that it is unlikely since few businesses and other real-world computer applications can be done with mobile devices alone (p. 3).

Research in this area seems to ignore the impact of these findings within smaller rural communities such as the one in this case. While there is a growing amount of research about the various incarnations of the "digital divide," very little addresses whether any of these problems are seen in rural communities, or whether they are unique to urban centers; clearly, there is an obvious gap in the research regarding digital education implementation.

21st Century Educational Needs

Learners of the 21st century have different and changing educational needs. There is a wealth of literature examining the changing landscape of learning. Friedman (2007), Chen (2010), and Christenson, Johnson and Horn (2009) all agreed that the knowledge needs of the 21st century learner are much different than even a few decades before, and

require new skill sets. Friedman posited a *quiet crisis*–an American population that loses innovative advantage to other nations–because of its educational system's inability to adapt to the needs of 21st century needs. The viewpoint put forth in *The World is Flat* (Friedman, 2007) seems to mirror the admonitions of *A Nation at Risk* (Gardner, 1983). Chen (2010) painted a similar picture: "...the past two decades of failing to modernize our schools, increase high school graduation rates, and achieve college success for a much higher percentage of students are the future of the nation" (p. 2). He went on to temper this assertion by identifying some of the best initiatives in American education today, that a growing number of progressive teachers, principals, superintendents and other school entities are embracing new technologies in school, in order to close these gaps. (p. 6)

Trilling and Fadel (2009) explained that "the world of *Knowledge Age* work, that is, the current state of world economy that values information, ideas, and data more than things, requires a new set of skills. Jobs that require routine manual and thinking skills are giving way to jobs that involve higher levels of knowledge and applied skills like expert thinking and complex communicating" (p. 8). Likewise, Christenson, et. al. (2009) asked whether "...the system of schooling designed to process groups of students in standardized ways in a monolithic instructional mode be adapted to handle differences in the way individual brains are wired for learning?" (p. 35). Similarly, Stuart & Dahm (1999), as part of the U.S. Department of Commerce report titled "21st Century Skills for 21st Century Jobs", explained that "global competition, the Internet, and widespread use of technology all suggest that the economy of the 21st century will create new challenges for employers and workers" (p. iii). This study argued for many of the economic changes

necessary as the job market changes, highlighting the need for more sophistication in skills:

> In the 21st century, American competitiveness and worker prosperity will be tied tightly to the education and skill attainment of the workforce. Recognizing that no one should be left behind, it is incumbent on everyone to build aggressively and purposefully upon the Nation's progress. (p. iv)

Clearly, the experts in this field have highlighted a clear problem with education in public schools today. In response, several reports have been put forth by the United States government and other entities in the past 20 years attempting to define the necessary workforce and life skills citizens will need in the changing economy and society. The literature and resources that resulted from these reports creates a larger picture of the needs of 21st century learners. The Secretary's Commission on Achieving Necessary Skills (SCANS): Final Report (1991) from the U.S. Secretary of Labor attends to this national conversation. This report outlined a textured series of skills to best connect to the needs of the U.S. workplace in the 21st century, including basic skills, thinking skills, personal qualities, and workplace competencies. The SCANS view is also endorsed and actively pursued by the International Society for Technology in Education (ISTE), who uses the SCANS profile as a cornerstone for their work in helping schools effectively implement crucial technology (ISTE, 2012). The Partnership for 21st Century Skills (2011), a leading organization dedicated to helping schools develop learners who "thrive in today's global economy," has outlined a framework similar to the SCANS report. The Partnership for 21st Century Skills (P21) poses a framework both for the benefit of educators and for students that includes life skills, technology integration, and

core knowledge. These are represented to reflect the interconnection of core subjects and 21st century themes and to show how assessment is intended to *reflect* these skills in measurable ways. This framework compliments the SCANS and other government suggestions for 21st century education. The P21 (2011) framework "requires the development of core academic subject knowledge and understanding among all students" (Partnership for 21st century Skills, 2012). ASCD has also outlined a vision of 21st century skills necessary in today's world in a position statement titled "Educating Students in a Changing World" (2008), which outlines the needs of learners to build digital, global communication and creation skills for the betterment of self and society.

Organizational Change Models

The case study will be addressed with a few lenses based upon current research. Two key frameworks that guide the collection of the anecdotal evidence in the field observations are that of organizational change and of human resistance to change. It is important to understand the current research regarding organizational change in order to determine how the selected schools operate and how that understanding impacts the key questions regarding technology integration. Understanding the research regarding human resistance to change, particularly within the realm of education, is crucial to understanding how personnel within these schools react to technology initiatives.

Organizational theory will allow the researcher to frame the findings in a greater scope, by allowing the organizational structure to become part of the inquiry. Finding examples of innovative technology integration will tell part of the tale, but understanding why it thrives in this particular school district is yet another. The researcher believes that there are specific organizational influences that dictate the success in this case.

Taylor's (1917) *Theory of Scientific Organization* is the origination of the modern view of organizations, but it certainly is not the only voice in this complex discussion. Taylor developed a program for organizational improvement upon which four basic principles were held; finding the right way to do a task, finding the right people to perform the task, and replicating indefinitely. Collins (2001) builds upon this basic structure by suggesting that managers and administrators get the right people on the bus, get them in the right seats, and get the bus going the right direction. While Collins' vision is congruent with Taylor, the true question of how this generalized approach can be seen in varied situations, as we see in public schools. The principles can be seen at work in most school environments today. The concepts of *best practices* and *ability grouping* certainly seem rooted in Taylor's efficiency plans, or Collins' bus analogy. The criticism, according to Walonick (1993), is that "the philosophy of 'production first, people second' has left a legacy of declining production and quality, dissatisfaction with work, loss of pride in workmanship, and a near complete loss of organizational pride" (p.1). While the statement itself refers to organizations in general, it is clear that a similar effect can be observed in modern school organizations. In this model, the roles of the superintendent, principal, and other school leaders would be the linchpins of the organization. Indeed, this view has permeated the public school institution for much of its existence. Most current models do not support this theory of effective organizational management.

While Taylor's (1917) and Collins' (2001), and other related theories of organizational management have accurately described and informed most businesses and institutions for the breadth of nearly a century, other models were developed to

accommodate a changing world. Systems theory, a re-thinking of traditional organizational management suggests that not only are there few clear-cut answers when seeking Taylor- or Collins-style management efficiency, but that the environments and systems within which they reside can have far more impact on outcomes and efficiency than previously thought. Systems theory dwells more on relationships. Walonick (1993) outlined them as integration (the way activities are coordinated), differentiation (the way tasks are divided), the structure of the hierarchical relationships (authority systems), and formalized policies, procedures, and controls that guide the organization (administrative systems) (p. 1).

Clearly, the Taylor/Collins models are not fully forgotten here, despite the new focus. All four of these match closely with the Taylor model, yet the focus has shifted from output to input, (i.e. people). Walonick (1993) went on to explain that nonlinear views of organizational change is relevant, as many times organizations may see great variables in nonlinear aspects of the organizational structure, while the linear organization see changes very slowly (p.1).

Senge (1990) complimented this theory in a way that connects very well to school environments, coining his model the *learning organization*, that is, an organization that reacts well to change and grows organically. He set forth the following *component technologies* toward the understanding of how systems and organizations innovate; systems thinking, personal mastery, mental models, shared vision, and team learning. (p. 5) Senge described the interconnectedness of this theory as *The Fifth Discipline*, a unifying systems model that rethinks many of the paradigms of earlier organizational theory. This model is quite different than previous models by way of eliminating the

concept of *getting it right* and focusing on the ability for organizations to be proactive, change positively, and find effective structure in people and not gimmicks (p. xvi) This is particularly appropriate thinking in the realm of public education. Senge further outlined several *learning disabilities* of organizations, which according to him, inhibit the natural positive growth of the organization. So, too, do schools see similar learning abilities and disabilities. Senge points out that schools can be reformed to promote sustainability and vitality by becoming a learning entity. (p. 6.)

While Senge's (1990) model is not centered on school reform, it does build upon previous organizational theories to frame a new vision for schools as they attempt to break the chains of the 20th century model, and it has remained largely unchallenged in the years since. It is unclear whether Senge's model is the most accurate way to evaluate the organization of a school or school system. Kermally (2004) offered rare criticism to Senge's theories, particularly that the theory is too general and philosophical for real managers to explain to employees and that learning is too broad of a term, which leads back to basic training and not whole systemic change. This criticism may be relevant in the school setting as well. Again, there is a gap in the research. This case study may shed more light on whether successes in digital integration come from leadership or from whole-system approaches.

Despite the offerings of many researchers, there still remains much to be explained about why educational institutions adopt or resist using current technology, a question which this case study aims to shed further light upon. The literature uncovers many successes and failures in the implementation of digital technology in education. As

technologies used in education become more ubiquitous, the gap in research, particularly the unvarnished anecdotal realities, will be increasingly important to research.

School culture and climate

Though the concepts of school climate and school culture seem to be very similar, even interchangeable in many contexts, both terms indicate an overarching description of the relationships in a school. In this study, reference is made to school culture as it applies to both students and staff, but posits that culture in a school begins with leadership. Deal and Peterson (1990) saw school culture as "deep patterns of values, beliefs, and traditions that have been formed over the course of the school's history" (p.7).

Bryk and Schneider (2002) found that school culture was rooted in relational trust (p.12) between people within the school, but also noted that there were many levels of trust among members of the school group, from intrinsic, organic trust to contractual trust (p. 17). Freiberg (1998) adds, "school climate can be a positive influence on the health of the learning environment or a significant barrier to learning" (p.22).

School leaders are often tasked with changing the culture of the school. Clifford, et. al. (2012) suggest that "principals, as school leaders, are ultimately responsible for all that occurs in a school building" (p.2). They further suggest that school climate assessments are necessary for all stakeholders (p. 3).

School climate/culture considerations are important when considering technology integration initiatives. Stolp (1994) notes, "In an environment with strong organizational ideology, shared participation, charismatic leadership, and intimacy, teachers experienced

higher job satisfaction and increased productivity," which connects well to modern technology implementation efforts.

Specific digital integration endeavors

Several particular strategies to digital integration are present or emerging. Like many other schools across the United States, the public schools in this case are seeking to leverage the power and promise of internet-based tools, interactive white boards, and mobile devices. A growing wealth of data (Edyburn, Higgins, Boone, 2005; Geer, Sweeney, 2012; Stratham, 2012; Tremblay, 2010; Reeves, 1998), support the use of these tools and strategies in educational settings.

Internet-based tools. For many years from the founding of the World Wide Web until the mid-2000's, the internet was largely used as a depository of information and resources. In 2005, O'Reilly, explaining that the "dot-com" bubble bursting ushered in new thinking regarding the internet. O'Reilly coined this new phenomenon "Web 2.0," in which not only was information readily available, but was increasingly user-created. (p.1)

This new use in digital technology was not immediately embraced by schools. Many saw websites such as *YouTube* and *Wikipedia* as frivolous and entertainment-based, and did not see immediate legitimate impacts to education. Kelly (2009) described the core objections to these new waves of technology, and technology in general as being contrary to Nature, Humans, and to God (p.1). Young (2009) more specifically discusses the use of computers during lecture times, which he claims, leads to more boredom (p.1). United Kingdom teachers in 2007 even voted to eliminate the internet, particularly *YouTube* and web 2.0 technology completely from British classroom due to unknown dangers, possibly including WiFi brain damage from radio waves (Fay, 2007). More

credible oppositions such as online bullying (Dowell, 2009), and internet addiction (Poll & Agrimi, 2007) were often cited as specific concerns in the classroom.

Despite the clear opposition from many education stakeholders, Internet (web 2.0) technology has become a mainstay in education. Selwyn, (2007) characterizes the emergence of web 2.0 strategies "seen to form an important element of the digital landscape of many learners which is decidedly outside the control of the education institution (p. 3). Maloney (2007) argues that the emergence of web 2.0 strategies have transformed educational possibilities by engaging users in two-way creativity and collaboration (p. 2).

For instance, the emergence of video sharing sites such as *YouTube*, and screen-capture software such as *Jing*, have had a large impact on what many educators are calling the "flipped classroom model." Bergman (2011), one of the pioneers of this model, explains that the flipped classroom, while not dependent upon video, finds video and other internet resources at the heart of the concept. In this model, students watch recoded video lectures and explanations at home on digital devices, and then work with concepts in peer groups or one-on-on with classroom instructors. (p.1) The success of this model is still being researched, but educators like Greg Green of Clintondale High School in Michigan (Roscaria, 2011), Dana Legett of Allen High School in Texas (Hammett, 2011), and Karl Fisch of Arpahoe High School in Colorado (Fisch, 2012) and many others are finding success using video lectures to engage learners.

Web 2.0 tools such as *Wikipedia* are also showing an upswing in educational acceptance. While most in academia would still tend to agree with Michael Gorman (2007): "A professor who encourages the use of *Wikipedia* is the equivalent of a dietician

who recommends a steady diet of Big Macs" (p. 1), educators are finding more uses for computer-aided tools for research. Research in the middle and late 2000s uncovered an increasing amount of evidence that sites such as *Wikipedia* were actually relevant and important sources of information. Giles (2005), Wood and Struthers (2010), and Miller, Helicher & Berry (2006) have concluded that in general, *Wikipedia* is an adequate source of information, in many cases comparable to encyclopedias and other research tools. Teachers such as T.J. Wolfe (2012) urge that "since *Wikipedia* has over 20 million pages, and 90,000 active editors and contributors, it's a powerhouse of resources. We should be able to use this information to focus on creating solutions to our world's most challenging problems."

Other tools, such as *Moodle, Desire2Learn, Blackboard,* and *Edmodo*, sometimes referred to as learning management systems (LMS), allow for educators to connect students with materials and other resources outside the confines of the classroom, while also add the ability for students to interact with each other and in some cases, the world. Fardoun, Alghazzawi, López, Penichet, Gallud (2012) discuss the connection between social networks like *Facebook* and the success of LMS like *Moodle* and *Edmodo*. There is evidence that these LMS are positive tools in learning. Brandl (2005) explains that *Moodle*'s power lies in the fact that it is open-source, free, and "a teacher's dream." (p. 2) Bremer & Bryant (2005) agree to the power and usefulness, adding that users of Blackboard software find *Moodle* just as rewarding to use, perhaps more so. *Edmodo,* relatively new to the LMS market offers many of the same features as *Moodle* and *Desire2Learn*, but in a more user-friendly interface. Fardoum, et. al. also reported high

engagement rates and out-of-class visits to the *Edmodo* site. (p. 7) Tools such as these are also used in successful implementation of a flipped instructional model.

A final internet-based tool emerging in schools is the use of cloud-based document interaction services such as *Google Apps, Evernote,* and *WikiSpaces*. These tools allow for students to create documents that can be shared, viewed, edited, collaborated with, and otherwise interacted with by several people globally without need to save to hardware or to transfer physical files or memory storage devices. Nevin (2009) concludes that interaction, collaboration and assessment are all enhanced when working with *Google Apps* (p. 36). Al-Zoube (2009) explains how *Google Apps* supports many of the same features seen in *Blackboard* and *Moodle*, but in a more user-friendly way. (p. 60) Soule (2011, p. 29), Yoshida (2010, p. 32), Jahnke, Bergström, Lindwall, Mårell-Olsson, Olsson, Paulsson, & Vinnervik (2012 p. 153) and many others list *EverNote* and *WikiSpaces* as some of the many effective 21st century web 2.0 tools available free, that faculty can begin using immediately in practice.

Interactive tools. Common interactive tools used by educators today are interactive white boards (IWB), such as the *SMART* or *Promethean* boards. There is a large debate among educators regarding the true benefits of these boards, despite the fact that they are becoming a very popular educational tool across the U.S. Smith, Higgins, Wall & Miller (2005) concluded that IWBs were generally well accepted by students and teachers, but cautioned that the success in the classroom was dependent upon the instructor's creativity and knowledge (p. 59). Campbell (2010) agrees that IWBs are valuable tools for the classrooms, but did mirror Miller's concern that teaching ability and preparation was a key factor in success using IWBs. (p. 74). Not everyone believes

in IWB technology's promise of transformative education. Stager (2012) characterizes IWBs nationwide as underused, overpriced gadgets that encourage lower-level learning and poor teaching. "At a time of enormous educational upheaval, technological change, and an increasing gulf between adults and children, it is a bad idea to purchase technology that facilitates the delivery of information [as opposed to discovery] and increases the physical distance between the teacher and learner" (p. 1). The literature seems to indicate a generally positive approach to IWB, as long as instructors are using them according to best practices.

Mobile devices. A recent major addition to the classroom, digital mobile devices have become much more prevalent in classrooms since 2010. Relatively unused in education, the 1999 release of Apple's *iPad* tablet changed the attitude of many educators regarding the use of tablet devices in classrooms. Today, 1:1 tablet programs are emerging all over the nation. The allure is easy to see. The *iPad* is lightweight, powerful, and very portable. While 1:1 models in schools are only now being heavily researched, there is some evidence that *iPad* and other mobile devices are valuable additions to the classroom. Foote (2012) discusses her school's use of *iPads* among faculty and students as having increased productivity and reducing the use of paper (p. 15). Many other teachers (Cohen, 2012, for example) have seen and enjoyed the interactions and usefulness these tablets offer. As the 1:1 tablet trend continues, researchers continue to find that while the tablets may be a somewhat overrated, they offer a multitude of benefits including the replacement of textbook content, the relative low cost, and ease in use (Murray, Orrin, & Olcese 2011, p. 46).

Summary

The research conducted at the case study site helps to answer important questions about the implementation (or lack) of digital technology. The case provides authentic understanding of how broader concepts in digital implementation are seen in the actual classrooms of a public school. Bringing the abstract promise of digital tools in education into more concrete examples helps to build evidence that aids others in considering these strategies and tools in the future. The literature relating to the case is varied and filled with gaps, particularly due to the relatively recent developments in digital technology seen in use at the school sites. Obvious gaps in the literature include a need for much more data regarding the actual success of (not just instruction in) the flipped classroom model and the use of web 2.0 strategies in the classroom. These technologies are still relatively new, and as time progresses, the academic community will fill this void with richer information regarding actual outcomes of the newer digital strategies. What is clear in the literature is that web 2.0 sites, interactive white boards, and *iPads* are among the most popular and promising digital strategies in practice today. Time will tell if the promise bears out, or if other tools improve upon and replace the digital tools currently in use.

It is important to note that while the technology is in flux, the concepts surrounding 21st century education and organizational theory remain fixed structures in the study of modern schooling, and create crucial pillars for researchers to frame inquiry relating to how schools innovate with digital technology.

Chapter III

Research Methodology and Design

The purpose of this chapter is to outline the research methodology, to provide an understanding of the specific research design, and to explain how this methodology leads to the data collection and analysis. The case study focused on interviews and observations within the middle/high school building site primarily, although the district itself was the subject of the larger observations and conclusions of the study. The study centered around semi-structured interviews with key educators within the system, and culminated with an analysis of the school district's ability to integrate digital technology and 21st century pedagogy and discussion of the district and school culture as it relates to digital technology. The primary research question in this study was whether successful integration of digital technology in schools can be attributed to specific practices or policies.

Site Selection

The selected school district was chosen because it, while demographically and systemically similar to many school districts in Minnesota, is unique in the many successes in implementing digital instructional strategies and tools. The district has a history of embracing digital technology. According to the principal at the primary school, several classrooms are equipped to deliver video-conferenced class extensions, all faculty are given iPads to use in their instruction, and the district is currently planning to roll out a 1:1 iPad initiative that will put a dynamic computing tablet in the hands of every student in grades 7-12. Online resources such as *Moodle, Edmodo*, and *Google Docs* for Education are widely used by administration, faculty and students. There are several staff

members who are technology integration leaders or coaches, who help the faculty implement digital technology, and who also evaluate its success. Several faculty members have piloted new digital tools and strategies in the past year or two. Several computer labs are available for classes and individual students to use, each set up for specific purposes. It is apparent the district has a clear vision for how digital technology fits into the education of students in the district.

The selected school district lies within the heart of a largely rural community in Minnesota, approximately 50 miles south of the Twin City metro area. The city's 2011 population was 11,196, and is the county seat. Estimated median household income in 2009 was $41,000, and the median home value was $158,000 (city-data.com) The county is largely rural, with a few industrial areas to compliment local agricultural economy. The city is both an agricultural and academic center, and four-year private liberal arts college is located within the city limits.

The school district serves just under 2000 students, K-12. The superintendent has been in the position since 2003, having been principal for the 10 years preceding. In choosing this site, I was able to spend a bit of time with two of the building principals and the superintendent, to better understand the possibilities of the district for this study. After the study was approved by committee, I spent two additional visits to the school taking tours and meeting people before actively beginning the study.

According to the secondary principal, the 2012 student demographics of the middle/high school (7-12), where much of this study took place, indicates approximately 90% Caucasian students, 7% Hispanic students, and 2% African-American. The school enjoys a 94% attendance rate, and 97% of students graduate. Approximately 22% of

middle/high school students are on free or reduced lunch programs, and 16% are identified as having special education needs. (personal communication, July, 2012)

The high school operates on a modified block schedule, with core classes lasting 95 minutes, while some other classes and electives meeting for 45 minutes per class. Students in the high school complete a capstone independent project in the final year. Nearly 80% of the school's graduates attend post-secondary education. (personal communication, July, 2012)

The middle school concept utilizes a "house concept," whereby students are organized in two "houses" per grade, allowing for flexibility and communication between teachers, students and parents. Students take a full course load for grades seven and eight. The middle school concept aims to offer a variety of learning experiences, and endeavors to create interdisciplinary study whenever possible. (personal communication, July, 2012)

There are approximately 55 faculty members at the middle/high school building. All faculty are fully licensed and deemed "highly qualified" under No Child Left Behind mandates. Sixty-two percent of the faculty have attained a Master's degree or beyond, and five are either nationally board certified or were nearing nearing certification at the time of my inquiry. The building employs a full-time media specialist, two full-time school social workers, and two guidance counselors. (personal communication, July, 2012)

Research Design

The intent of this research was to determine the level of digital integration within the infrastructure of the district, particularly in the 7-12 secondary building. Methods used to research the question were limited to classroom observations, and verbal

interviews with faculty and administration to ascertain their feelings about support structure, educational freedom, and overall influences leading to positive digital integration practices. I also toured many of the facilities, and was able to learn more about the different digital tools used in the school. The qualitative data that resulted is written up as a summary of the positive choices the district and its personnel have made in order to integrate technology successfully, as well as providing discussion on the elements that seem to best create the successes in the school or district.

In order to understand the real workings of this school district, the researcher must get inside the school and ask questions of teachers and administrators. The most appropriate method to do this is the case study. Using "thick, rich description" (Merriam, 1998, p. 5) of a case study will result in a clear understanding of how schools learn to innovate. Merriam, in *Qualitative Research and Case Study Applications in Education,* explained that "the single most defining characteristic of case study research lies in delimiting the object of study, the case" (p. 27). Understanding the case, or "bounded system" (p. 27) as Merriam described it, is key to understanding both whether the situation represents a clear case study and also how, if indeed it is a case, it may be delimited in a way that *fences in* what is to be studied. This case study was delimited in the following manner:

1. The study focuses only on the aspects of the school culture, procedures, and leadership as they could reasonably be construed to affect innovation and technology use.
2. The study did not consider variables in school systems which affect how schools innovate, but cannot be changed by the implementation of different

strategies, philosophies, or leadership. In other words, if a school system faces a challenge beyond what can be reasonably affected by the effort of the school system, it was not be considered. An example of this would be unemployment or poverty in the community in which the school system resides. While this variable may well influence the use of technology in the district or the level of innovation seen in schools, it is unreasonable to believe that the school system can solve the challenge directly.

3. Within schools, there exists a logical limit to how many people may be observed, how many people may be interviewed, and how many visits to the site may be accomplished in a given amount of time. I determined that a minimum of 6 faculty members and all of the administration would be interviewed in some way, and I exceeded that number. There were also several additional interactions that helped the study without being part of the main focus. I did not set out to visit with every member on staff, but I did interact with a great majority of them at some point in my study.

Merriam (1998) set forth several types of case studies, as described briefly below:

- *Descriptive* - a detailed account of the phenomenon under study. Useful in presenting general information about areas of education where little research has been conducted
- *Interpretive* - used to develop conceptual categories or to illustrate, support, or challenge theoretical assumptions held prior to data gathering
- *Evaluative* - involves description, explanation, and judgment.

- *Multiple Case Studies* - involves collecting and analyzing data from several cases, and can be distinguished from a single case study that may have subunits or subcases embedded within. (pp. 38-40)

This study would be best described as interpretive. Merriam (1998) described the interpretive case study researcher as "gather[ing] as much information about the problem as possible with the intent of analyzing, interpreting, or theorizing about the phenomenon" (p. 38). Indeed, I believe strongly that there are ways any school system can innovate effectively. The observations within this case study sought to illuminate how an effective school is proving that notion to be valid. As mentioned in the review of literature, there are many well-supported theories about the importance of technology innovation and its effect on student achievement, yet case studies on what is actually happening in schools are few.

Rationale

The rationale for selecting the case study method for this study is important to the validity of the study itself. There are advantages and disadvantages of using this method. While the results of a more quantitative inquiry may have provide data that has greater impact in understanding the degree of computer or Internet usage, it would not reflect the learning experiences of students, nor does it illustrate the satisfaction of teachers who use them. The case study is the best way to pursue the research questions, a criterion established by Merriam (1998). As Merriam explained, "the case study offers a means of investigating complex social units consisting of multiple variables of potential importance in understanding the phenomenon" (p. 41).

Within the confines of this case study lies the approach. This study–while grounded deeply in educational strategies, technological and societal advances, curriculum, and pedagogy–is about people. In education, the more scientific the lens, the less this fact is considered fully. Senge (2006), in *The Fifth Discipline: The Art and Science of the Learning Organization*, highlighted the relationship of people to the systems they operate within. In the case of these schools, the system. it seemed, was learning and developing at a greater rate because of the people who have shaped it.

The concern was that oversimplification of the observations may have resulted in half-truths–that is, situations where the phenomenon would have been observed in a vacuum, without the proper context to truly offer understanding. As this study is intended to be beneficial to public schools in general, the intention was to portray what was happening in a way that was accessible to most educators. For that reason, a case study was selected. As Merriam (1998) suggested: "using common language, as opposed to scientific or educational jargon, allows the results of the study to be communicated more easily to non-educators" (p. 39).

The Research Participants

The intent of this research was to determine the level of digital integration within the infrastructure of the district, particularly in the secondary building. Methods used to research the question were limited to verbal interviews with several staff members to ascertain their feelings about support structure, educational freedom, and overall influences leading to positive digital integration practices. Observations of the teaching environments, particularly while students were present, were also particularly valuable. Research also included interviews with three building leaders, as well as the district

superintendent. Other interactions with school staff happened by chance, and added context to the research.

Data Collection

Data collection was reliant upon interviews with key faculty and administrators, resulting in the creation of meaningful depictions which informed and described the culture and practice. In order to determine the origins and successes of the digital technology vision, select faculty and administration were asked questions regarding the culture of integration that seems to be present in the school district. To add additional context, learning environments were visited, and in some cases, classes were observed with students in attendance.

Non-structured and semi-structured interviews. Seeking information, opinion, and impressions from as many key individuals involved in the school culture was crucial to understanding how the school culture came to be, and how it operates presently. Whenever possible, interviews were spontaneous and as authentic as possible. A great deal of effort was made to create an environment where respondents could feel comfortable sharing, without feeling tied down to appointments or restrictions in formal interview settings. The use of recording devices was not pursued, as the researcher believed that people would be more comfortable, and therefore most helpful to the study, if they did not feel they would be digitally recorded.

In order to determine the origins and successes of the digital technology vision, school leaders were asked questions regarding the culture of integration that seems to be present in the school district. Through brief conversations with school staff, a few initial targets for faculty interviews were identified, and further conversations led me to others

who became part of the study. Both administration and faculty members were asked for ideas as to who would be valuable to speak with. The goal was to speak with a diverse group of staff members.

In most cases, I was able to visit the classroom of a teacher during a school day at least once, and in some cases twice, while class was in session. I was also able to speak with participants before or after a classroom observation in order to visit with them about what was happening in the class and school. I began with a framework of questions that related to my research inquiries, and I openly encouraged the conversations to stray from these to any other related topics that were necessary. I made a point to allow the person I was speaking with to do a majority of the talking, and I took detailed field notes on what was discussed.

Some key questions that began the administrator interviews:

- Please describe your role in choosing and supporting the use of digital technology in the school or district.
- Please describe specific initiatives that lead to decisions regarding digital utilization in the school or district.
- What have been the best or more successful aspects of the technology and innovation plan currently in place?
- What challenges do you feel impede or slow the adoption or use of educationally relevant technology use?
- What is next on the horizon, in terms of technology integration, for the school or district?

- Can you identify staff members who exemplify the vision for digital technology integration for the school or district?

The questions that framed the interviews with the faculty participants consisted of the following:

- Please describe how you have integrated digital integration into the curriculum, practice, or culture of your class or department.
- Please describe specific initiatives that lead to your decisions regarding digital utilization in the school or district.
- What have been the best or most successful aspects of your technology and innovation efforts?
- What challenges or barriers do you feel have impeded or slowed the adoption or use of educationally relevant technology use in your school or district?
- How do you evaluate the effectiveness of your integration efforts?

Demonstrations and tours of facilities were offered in order to better understand how the integration was happening in the classrooms or in the building itself. I was given a complete tour of the secondary building three times, once by the technology integration specialist, who highlighted many of the key components of the administration and technology support staff. The second was by the secondary principal, a personal acquaintance of mine. He pointed out the departments and general layout of the building. The third tour was of the general administration spaces and offices, led again by the building principal. In each of these tours, I was introduced to staff members.

Observations and field notes. The observations and interactions that happened within this case were noted in a field journal. At the time of the interviews it was

integral to view some of the learning spaces mentioned in the interviews, view specific technology, and further investigate how the students interact with the technology and how it is integrated into learning. Some of the observations were done during a typical learning day, though some were done at times when students were not present. The collection of this data was done by taking handwritten notes as I visited with people, and as soon as possible, translated digitally in the form of an online document which allowed for access anywhere and any time. By collecting data at the moment, and writing about it on site, there was high level of accuracy, which allowed me to effectively reflect and draw conclusions.

I made frequent notes on reflection about the inter-connectedness of the different ideas that revealed themselves in the observations and conversations I had while in the school. I was able to ask the principal and others in the district follow-up questions as they came up, which further added context.

Data Analysis

The first and primary concern in analyzing the data collected through interviews and observations at the site was to examine how they answered the research questions presented at the beginning of the process. As the qualitative data revealed insight on the research questions, anecdotal and speculative explanations were crafted through the use of descriptive narrative vignettes depicting of the nature of digital integration.

Summary of Methodology

This case study was carried out as an investigation of the reasons, ideas, and philosophies of the people responsible for attempting to implement technological innovations. The case study model was appropriate due to the multitude of possible

variables, many of which were rooted in human interactions and systemic variations. The existence of positive learning environments in this school system was not in question. What was in question, however, is how this system evolved to get to this stage.

Chapter IV

Case Study

It is difficult to identify a culture of innovation or to accurately assess how a school or district utilizes digital technology effectively without seeking a holistic understanding through the thematic analysis of individual stories. In the case of this school, there are many stories to be studied. This chapter highlights some of the many great examples of successful digital integration in this 7-12 grade public school, and illustrates the philosophies and intentions of the administrators involved in building a culture of innovation in the district. The vignettes and descriptions are blends of casual conversations, unstructured interviews, observations, secondhand information, and are meant to portray the educational environments and the educators that drive them in an authentic manner.

Each of the following vignettes will first provide a description of the learning environment and the instructor, and will then examine one or more examples of digital integration or philosophy related to digital integration. A section regarding administration observations and study will follow the educator vignettes, each outlining the leader's influence on the digital culture in the district. Each vignette, regardless whether it is for an educator or an administrator, will conclude with a brief summary that places the observation in the context of the research questions. These connections, themes, and issues will be expanded upon in the following chapter.

Educator Vignettes

Flipped math class

Mr. K. is a 20+ year veteran in the math department at the school, and is piloting a flipped-classroom with a technology heavy model for his department. His approach is natural and unforced, and students observed in the class were extremely comfortable using the technology piloted in this classroom.

The physical classroom, while not larger than typically seen in public high schools, is arranged in pods of four desks. This allows students the ability to collaboratively engage in learning dialogue. Mr. K.'s class is well managed, yet has a loose, unstructured feel about it.

On one particular day, students filed in and instinctively selected their assigned Sentio responder (small, handheld Internet response devices) from an insulated case located near the door. It became clear that the students have become so accustomed to this step in entering the room that there was no discussion about it or seemingly any conscious thought in the action. Mr. K. had previously placed a paper test, scratch paper, and what appeared to be a set of instructions on the desks prior to the students' entry. As they were seated, nearly all of the students produced a calculator from a pocket or book bag. Students did not appear in distress regarding the impending examination, but seemed comfortable taking a few moments to arrange the various materials on their desktops. Nearly all of the students placed the responder at the top right of their desktop, where it stayed for a majority of the test period. None of the students were observed playing with or even mindlessly fidgeting with the responder as they continued the test. Students worked problems on the test using their calculators. One student's raised hand brought

Mr. K. to investigate, but the question was swiftly resolved, and the student silently nodded while turning attention back to the test paper.

When the students finished taking the test, they pushed calculators aside and reached for the responders. Some students grasp them in both hands, others in one hand, and they began pressing buttons to choose the answers on the test. There was little consternation or difficulty; it was obvious that this process has been executed dozens of times since the beginning of the school year. Mr. K. sat at his desk, alternately looking at his computer screen, which showed spreadsheet slowly filling in with data, and looking out at his class as they punch data into the responders. Moments later, Mr. K. sends individual results back to the students, who viewed this data on the responder screen.

Other days, Mr. K. uses the responders in combination with his SMART board to elicit answers from the class during class discussion. He shows a slide displaying a problem on the board, and students work the problem at their desks. When they feel they have reached the correct answer, they enter the data into the responder, and answers begin to appear on the screen at the front of the class. In some cases, Mr. K. may address common incorrect answers, but in most cases, he uses the resulting response as an indication of how well the class understands the material. He quips that in the traditional setup, he never really knew where the class understanding was. This instant formative feedback not only allows students to answer without negative stigma from others (the responses are anonymous), but also helps them see how well their peers understand the material.

At home, Mr. K.'s students log into his Moodle online website, where he posts instructional videos and other materials as a lesson the students learn from. Students are

able to work with the materials at their leisure, not pressured by graded problems or deadlines for specific graded work. When they come to class the following day, Mr. K. assesses the knowledge gained by the students, and then re-teaches and offers more time to practice solving the problems.

Mr. K. shared that the combination of the responders and the flipped instructional model have greatly enhanced, even transformed, the way the students learned. He explained that at previous parent teacher conferences, parents had been overwhelmingly positive about the flipped model of instruction. He explained that his students genuinely enjoy the different approaches to learning algebra, and that students have gained a sense of ownership over their own learning. While performance by these pilot groups is as yet inconclusive, he shared that he feels the class is moving through the lessons faster and at higher level of understanding, and that the overall quality of the assigned work is much better than in his traditional classes.

One of the research questions in this study is: what systemic constructs aid in implementation of digital technology? The system present in the school produces strategies and norms that reflect a conscious effort by the teachers and the school administration to pilot new programs, such as the flipped classroom strategy. It also reflects a willingness to invest in specialized devices for education, such as the Sentio machines. It was clear that the students were very comfortable within this environment, suggesting that the instructor was good at implementing new strategies in the class, and perhaps also that students in this school are used to systemic changes such as the piloting of new devices and strategies. The teacher believed that the students pick up on new

approaches very quickly, and do so better every year. Clearly, the system itself is a contributor to the successes in this class.

Multi-media instruction in Spanish class

In a high school Spanish classroom, Mr. E. finds many ways to use technology to bring language and culture to his students. He uses frequent PowerPoint and Prezi slideshows to share visual connections to the topics that are discussed in class. Mr. E. teaches in a typical classroom with student desks arranged in rows and columns, facing a large screen to the front of the room. He is, himself a very relaxed and casual instructor, and it is clear he has great rapport with his students. The classroom atmosphere was observed as unstructured but focused. It appeared that there were students of different grades in the class.

On one particular Friday, students were treated to a presentation and celebration for Dia de Muerto, or Day of the Dead. Mr. E. began class by addressing the agenda in Spanish (he rarely spoke English), which was accompanied by a colorful digital poster on screen, surrounded by the agenda items. He introduced a student whose family is from south Texas, who would be sharing some family traditions for the holiday near the Mexican border. An impressive physical display was set up at the front of the classroom, complete with a shrine of a loved one, some decorations and props used in the celebration, and other related materials. As the student talked, Mr. E. sat at his desk and opened digital pictures that accompanied the student's remarks. Some of the pictures were of her family and family's home, but others gave a visual image to accompany parts of her presentation. He quickly moved through the prepared picture slideshow and other related visuals to enhance the presentation. When the student was finished, Mr. E.

invited students to join him in tasting some traditional dishes appropriate for the celebration. He displayed the recipes and ingredients (in Spanish) on screen as they were discussed. It was clear that the visual component is a cornerstone of his instruction. He used his iPad to do attendance as the class dove in to fresh Pico de Gallo and other prepared dishes.

In our discussion, Mr. E. mentioned using Google Voice, an online-based format for making phone calls for vocal instruction. Students dial a designated number from their own phones during non-school hours, and are greeted by a voice-mail announcement from the teacher, asking them to recite into the voice-mail recording. Students are then able to perform vocal recitation at any hour of the day, and Mr. E. can access the recordings at will to evaluate. He described it as a real breakthrough in his own time management, as individual recitation is a crucial component of his language instruction, and he is able to now have students do this outside the class period. He has used it several times in the first quarter of the class year, and he shared his belief that every student has successfully utilized the Google Voice tool at least a few times so far.

Since YouTube has so many Spanish language videos, Mr. E. also frequently uses this online video site to share interactions, songs, dramatic scenes and anything else of interest in Spanish. He explained that this is a crucial way for students to interact with authentic Spanish-language materials.

The comfort this instructor displays with this technology reflects a response to a work culture that promotes teacher innovation in their content fields. This further illustrates the systemic norms that allow for continuous innovation. It seems that the school and department are supportive of his efforts, and that they value his approach as

much as the students do. It was unclear as to whether these ideas and strategies evolved with the class, or were heavily influenced by others in the school. Because others in the Spanish language department were also mentioned as strong technology users, it is reasonable to assume that some of these strategies are norms of the department.

Digital media center

In the media center, one can easily find Mr. S. working with students and technology. His library is both traditional and digital, with three full computer labs attached to the main area of the central library. Students and teachers can check out computer lab time, digital devices, and books. All materials are catalogued and monitored using online software. The entire environment is connected digitally. While Mr. S. has decades of experience in working with various media, he has tried to remain on the leading edge of digital media and learning. He admits he has been more than once enamored with digital devices that were only briefly relevant, yet his daily commitment to helping student access modern media has not faltered.

On one visit, Mr. S. was observed in his office assisting a junior high student with an Amazon Kindle e-reader. He and the student conversed about the particular issue at hand, which was how to reboot the systems on the machine. After a few moments, Mr. S. decided that it may be more than a few minutes to solve the problem, and switched the machine out with another he had sitting on his desk. He entered the change of ownership into the online spreadsheet on his desktop computer, and wished the student good luck. The student left the office smiling, as the screen lit up and he was able to begin interacting with it. Mr. S. shares that the culture of the school allows for a comfortable setting for such interactions. He explained his belief that students seem to feel an intrinsic

desire to connect with him and other staff members because of the mutual interest in technology, which closes perceived generational or cultural gaps about technology.

Likewise, he described a similar change in the culture of teaching; the motivation many teachers have with technology as "intrinsic" and it permeates much of what they do in the classrooms. He mentioned the heavy usage of classroom computer labs, laptop and tablet carts, and other materials intended for use with entire classrooms.

The media center also offers several digital devices for students to check out and take home. There are e-readers, digital cameras, and laptop computers. According to Mr. S., nearly all of the laptop computers (at least 30), and most of the e-readers are checked out daily. The check-out system is housed on Infinite Campus, an online student and teacher data center typically used by teachers to register and share grades. In this case, the site is used to show the waiting list for various devices. Students go online, usually at school, and indicate device preferences on a designated interface through the media center area of the site. Mr. S. can then scan the bar codes of the devices to the appropriate students when they arrive at the end of the day to check out the devices, and track them until returned the next day. This streamlined approach has worked well, according to Mr. S., and he is pleased with the usage rates. He remarks that the check-out devices help many students who would not otherwise have access to computers or other devices at home, and adds that in many cases, parents are also able to use the devices.

Mr. S. explains how using bar codes and digital databases has expanded beyond the fiction and non-fiction shelves to the classroom textbooks themselves. Under a system implemented a few years before, all 7-12 textbooks used by teachers in classes are catalogued and checked out by students when they begin classes. Additional books are

available for checkout if students need them while working in the library. This system, connected to the Infinite Campus information management site, has become the norm in the school. Mr. S. believes it is a positive move by students and teachers alike. The Infinite Campus database system seems to help many aspects of the media center become entwined with the rest of the school.

Clearly, the media center and Mr. S. are part of a large infrastructure in the school, which makes digital integration a priority. One of the research questions in this study asks what this school does differently, and the media center is a good example. The immediate difference is the emphasis on digital media as the cornerstone of the media center, not books. This can be seen in the close proximity of the computer labs and equipment to other forms of traditional media, the fact that the stereotype of the traditional librarian gives way to a technology expert, and that in many cases information and reference material are available in a variety of formats interchangeably. Another difference here is that the overall approach is student-centered, yet progressive. It is representative of the culture of the school in that the media center is truly a service-to-student area based around helping student access help and information in a technology-rich setting. The traditional library may certainly have had many of the same aspects, yet the pervasive nature of technology integration within this area of the school was remarkable.

Industrial technology digitization

While not originally one of the targets of my inquiry, the industrial arts teacher, Mr. W. highlighted another key area of digital innovation in this school. The shop area was not available for specific observation, but it in a chance meeting, it became clear that

the industrial technology department utilized some advanced digital technology in its programs.

While visiting with the building principal, Mr. W. dropped into the principal's office to show the principal a few small plastic trinkets. Two of these appeared to be similar to plastic keychain fobs, and the other was a small round ball bearing with an internal cylinder, an external cylinder, and six ½ inch spheres between them. The teacher explained that these were all made on what he described as a 3D printer. The printer, he explained, lays down one micro-layer of plastic material on each pass until the three-dimensional object is complete. The ball-bearing was impressive, as it was both lightweight and precise. The mechanism spun easily and completely. Mr. W. explained that this was a newer machine the industrial technology department had recently acquired. The building principal was able to expand on this department's work.

Mr. W. and the other two industrial technology teachers have been a part of a program called "Project Lead the Way," which designated grant money, training, and materials to schools who wish to push STEM-related initiatives in the school. The principal, explained that Mr. W. and the rest of the department have a technologically advanced shop, where students learn engineering and fabrication techniques on industry-standard machines. They view their progress on monitors posted near the various machines.

One of the things the school and district seems to do differently is to allocate money differently, with more priority to technology expenditures. The initiative seen here seems to be a good example of how the school finds ways to fund digital technology and capitalize on investments.

Digital writing, publishing, and multimedia in language arts

Mr. B. is in his third year of teaching, his first at this school. He teaches tenth grade language arts, and has already earned respect among peers. He was mentioned several times in conversations about the school regarding digital integration leaders. His recent master's work involved digital writing as a way to transform language arts at the secondary level. He describes his instruction as a state of constant trial and error, as he endeavors to implement digital technology as much as possible into the curriculum.

He describes his general interest in education technology as a result of growing up with the emergence of the PC and eventually the internet. He shares that he sees the same wonder and curiosity toward technology in his own students, and he describes his role as a teacher as rooted in need to utilize technology tools as often as appropriate.

While he anticipates further integration when the students have 1:1 access to digital devices, he already uses digital means for many parts of his classroom. Students use Google Apps for assignment submission, read blogs and other web-based publications, and have created interactive media such as voicethreads, blogs, wikis and podcasts. He frequently helps students learn how to use digital tools, and where to access digital devices in and out of the school. His students use digital devices in class at least once per week, often more regularly.

Mr. B. explained that there are many benefits to implementing technology on this level. He noted the emergence of blended learning in higher education as a motivation to help his students prepare for an increasingly digital learning experience. He also talked about a movement to digital technology as a way to address common core standards and new learning at the K-12 level.

In this example, we see a digital native join a school culture rich in technology integration. It seems the interests and abilities of this instructor are supported not by the direct initiative, but by the supportive culture, which in itself is something this school does differently. His description of constant trial and error is similar to several of the philosophies of the superintendent, indicating a connection between vision and practice.

Digital tools for accessibility in special education

Ms. M. teaches the school's developmentally cognitively disabled (DCD) classroom. The classroom itself is a mix of workstations such as tables and desks, countertops and storage spaces, interactive toys and tools, assistive apparatus, and teaching spaces. She generally works with 6-8 students per class, many remaining with her for many parts of the school day. The students are ages 12-21, and have many different functional levels and individual needs. Three of her students use assistive technology (iPod or iPad) specifically for communication, and all of the others use various digital technology for communication enhancement, learning tasks, enrichment, and other needs as necessary. Several specific interactions were observed.

Ms. M. began one day's class with a slideshow of pictures taken of the group during a previous visit to the bowling alley. The students regularly use iPads to take photos and record voices in the classroom and on outings. The photos are shared between them and often become conversation and learning topics for the class. The slideshow shown during this particular class was contained on Ms. M.'s instructor iPad, and projected on a SMART board screen. As the pictures were displayed, Ms. M. asked questions about what was going on in the photos or whom they featured. One student used her own iPad to construct sentences appropriate to answer the question. When

ready, she pressed a button on screen, and a digital voice could be heard from the machine, answering the teacher's question. Another student relied almost entirely on his iPod handheld device to offer descriptive words connected to the on-screen photos. At one point, Ms. M. was asked by another student whether she had been sent the photos, indicating that it was expected that the photos are shared with individual students for further viewing. Another student who used a stander, a piece of equipment which holds the child's body in place in a standing position, also interacted with an iPad during the course of the slideshow, despite being challenged by major muscle tremors. A paraprofessional held an iPad which displayed pictures of the other students in class up to the student, and she was able to tap a picture responding to the student in question. Again, an electronic voice rang out from the device, speaking the name from the picture that was chosen.

Later, the same student was situated before the screen of the smart board, just mere inches from its surface. The screen flashed numbers in groups of two and three. The student was asked to select certain numbers based on the instructions given by the program. She was able to tap the board to interact with the number game, accurately, despite great physical difficulty in doing so. Furthermore, she seemed pleased to participate, even excited for the next opportunity. Ms. M. shared that before the use of touch-sensitive technology, this student had difficulty interacting with learning activities due to her physical limitations.

The use of assistive technology is a new yet welcomed addition to Ms. M.'s classroom. She has only been using the mobile devices the past two years, yet they have become an integral part of the students' development and communication. She shares the

story of a student and her family who explored assistive communication devices through medical assistance and insurance. The preferred device, a proprietary medical communicator was priced at approximately $7,000 through medical supply companies, yet had a fraction of the capability of the iPad and appropriate apps. She explains that the area of assistive apps is growing and becoming hard to ignore, yet the time needed to vet them properly is sometimes daunting. She has obtained two iPads with department budget in addition to the one she was issued as a teacher under phase one of the district's 1:1 iPad initiative. She said that the communication apps especially allow for a type of interaction and learning not previously available to her students. The assistive digital technology encourages more communication, interaction, and curiosity, and has opened some new worlds for her students.

The digital integration seen in this learning environment was remarkable. As the research questions ask about systemic structures and strategies, this was a great example. While most of the individual digital integration decisions were made at the instructor level, the existence of school wide initiatives, such as the instructor iPad program, certainly created those opportunities for integration. I was emotionally overwhelmed by the transformational quality of the technology use in this department. The teacher shared that before she was encouraged to explore more content with the iPads, she was not able to provide many of the learning opportunities she can now. It is clear that a very caring teacher was able to make great use of digital tools. It was unclear how much that was influenced by the school system or culture and how much was her own initiative, but both were important influences on the learning successes that result from a digitally integrated classroom.

Digital tablets as learning extensions in agriculture education

Ms. L.'s approach to education technology in agriculture studies was striking. She explained that contrary to what others may think, agriculture studies provide a great opportunity to infuse innovative approaches. Her agriculture program is one of three specialized programs (the other two are health and engineering), that are part of a cooperative of local schools. Some students from neighboring schools take these courses on-site. This arrangement allows for better enrollment numbers in the specialized classes, and makes it easier to fund. Her classroom is the hub of this program.

Her classroom looks to be more of a media center than an agriculture classroom. While small, it is connected to the world. One corner features a large flat-screen television equipped with AppleTV, a mobile wifi interface that allows multiple devices to display on screen wirelessly. Just to the left of that is a SMART board and projector setup. Around the corner is a mobile tablet cart containing approximately 25 iPads, each in a protective shell-type case. There are no student desks in this room, only large tables. Students typically sit around the tables with iPads, working on a project. She uses Evernote and other cloud-based solutions for sharing articles, book excerpts, graphs, and pictures. As they work, she walks around and encourages them to share their work on the big screen through the AppleTV interface. She shows examples either on the SMART board or on the television, and students can then get digital copies of any materials through the network.

Outside the classroom, the class takes the technology with them. They have a bus designated to them for outings, and the students bring their iPads along for the ride. Ms. L. describes the bus as "WiFi on wheels," because the bus itself has a wireless Internet

modem equipped. If the class visits a field to look at soil samples, they can document it using the camera on the iPad, and access other information wirelessly at the spot. They can visit a farm or other site and have the full capability of the iPads at the tip of a finger. While the range of this WiFi bus is still very limited, plans are in place to expand its reach to allow for more meaningful off-site tasks to be done.

An example of the kind of off-site work the students do in this class is the dissection lab. Mrs. L.'s dissection labs are a bit different than what most people might remember from their own high school experience. Her class takes their dissection lab to the county fairgrounds, where they are able to utilize a large space for dissection. The dissection guide is on an Evernote slideshow, and students dissect the animal with the iPad right next to the dissection tray. For evaluation, the students are asked to identify certain structures and photograph them with the tablet, making a visual record of their dissection. They can then label the pictures and upload those for evaluation later. Back in the classroom, the different pictures serve as multiple examples of the same structure, adding a further layer of understanding. She adds to these photos with video footage and 3D renderings of the various organs and structures to create a multi-faceted learning experience.

This was perhaps the most technology-rich department in the school. Ms. L. seems to be able to seamlessly integrate the different worlds of her classroom together using the technology available. It also appears as a great example of overcoming barriers, a key component in the research questions. Rather than struggle with an undersized program and budget, this department uses the power of the cooperative to gain numbers and relevance, which is then reflected in successful grant proposals and funding for

technology to make for a stronger program. The program seems to break paradigms of typical agriculture programs by embracing technology and making it a priority. This was an area of the school the administration was extremely proud to showcase, largely because both the teacher and the environment represent the type of learning that is most highly valued by administration.

Digital formative assessment and creation in language arts

Mr. A. is a second-year language arts teacher who has integrated digital technology into a great portion of his pedagogy. He teaches ninth grade students, with one section of a tenth grade advanced class called AVID.

He teaches in a typical classroom arranged of rows and columns of desks, with a teaching station comprised of not much more than a laptop and a few other assorted materials. The focal point of the classroom is a SMART board and a traditional whiteboard.

He uses a site called Wikispaces as a "home base" for his class, posting all classroom assignments and materials. He uploads Microsoft Word documents relating to anything that was handed out in class. He also frequently has students write digitally. Instead of bringing the class to a computer lab, he frequently brings in laptops on a mobile cart for students to use as they write. He also utilizes his SMART board often to display visual material, write on documents being displayed, and to facilitate different kinds of assessments.

For formative assessments, he uses polleverywhere.com, a student-response site where students can use mobile devices or computers to enter responses for questions posted on the SMART board, and then see how the responses measure up. The teacher

makes a question online on the Poll Everywhere site, which results in a screen that can be projected on the board. Students are given instructions on screen as to how they can respond. For multiple-choice, each option is given a unique code by the site, and students may text the code with cell phones, or enter it through a site on the browser.

He claims he has come a long way with his use of the SMART board, finding it a great way to create lessons for reading, and to assess learning. He is also beginning the process of imagining ways to convert remaining conventional materials and assessments to digital format, in anticipation of a 1:1 student iPad initiative which may roll out during the following school year.

Here is another example of an instructor already a confident technology user flourishing in the supportive system present in the building. The infrastructure and culture allow for the instructor to implement digital learning opportunities that make sense for his classroom, with access to tools and support in which to do so. The research questions refer to barriers that are overcome, and this is another strong example. Many of this instructor's strategies would simply not be possible in schools with limited access to mobile computing stations, building wireless internet and administrative support.

Administration Vignettes

Technology Coordinator

As a result of several meetings and discussion throughout 2011, the administration team decided to create a new position for the district with the title of district technology coordinator to begin the 2012-13 school year. Previously, technology support and maintenance was divided among an IT specialist, an integration specialist on special assignment, and a technology support specialist. These roles were constantly

changing, and there was a need identified to create a position that oversaw the different aspects of technology at the district level. In the summer of 2012, the district hired Mr. L. as District Technology Coordinator. At the time of our meeting, he was on the job a little less than 6 months. He had previously worked at a nearby district for several years as a technology coordinator.

The position requires him to work with the administration team to create and implement the district vision for technology use, oversee all technology acquisitions and expenditures, and help to guide administration in making decisions related to technology integration district-wide. He is also the leader of the individual integration specialists and technology coaches in each building, adding additional technology support wherever necessary. He feels it is important to try to lead the district where it might not be able to go without his help. By all administration accounts, he is excelling in his new position, and he was knowledgeable and confident about the work he did when we spoke.

At the time of our last meeting, Mr. L. was helping the district and the individual buildings with several larger initiatives while realigning the overall support structure and other administrative tasks he has been charged with. He was assisting several teachers in piloting a flipped instructional model in their classrooms. Mr. K., a math teacher is the teacher he identified as having the best start on this pilot. He has also been instrumental in rolling out the first phase of the 1:1 iPad initiative, which involves staff use of tablets. This rollout had been ongoing since before his tenure, but his first year was the first full year where all faculty had tablets, and had received training as to how they can use the digital tools on the iPads to aid in instruction, produce lessons, and perform tasks related to the business of teaching classes. He had also been fully involved in an emerging

program to add STEM (science, technology, engineering & math synthesis program) support and integration into the upper intermediate classes. The most recent changes in regard to this program had been to add a STEM rotation of instruction into grades 3-6, and to move from traditional library/media time to time with a STEM teacher. This program would eventually expand to enmesh other related programs in the district, creating a district-wide STEM strand through all grades.

As part of a continuing program of faculty development, Mr. L. and building administrators began the year by asking all teachers to take a survey to identify their individual skill and knowledge of education technology. This began a conversation among the faculty that developed further as the school year continued. He found that many of the teachers who might have identified themselves as quite technology literate and comfortable, did not find this reflected on the survey. He explained that many teachers become pocket experts in one particular strategy, without expanding into other related areas or evolving the overall integration of technology. With this data, Mr. L. and building support and technology coaches assist teachers in developing further integration strategies, using digital tools, and understanding philosophical rationale for technology integration. Teachers are asked to build new lessons that integrate digital technology, and are evaluated and supported as they do so.

A review of one of these lessons is part of the professional evaluation and development system in the school. Mr. L. or a building administrator will observe a lesson the teacher identifies as a digitally integrated lesson, and follow up with a conversation about intent, success, and further growth. Mr. L. finds this a key component of the overall success in building the culture of innovation as it is envisioned by

administration. He discovered that the wraparound structure of the administration technology integration expectations for teachers mirrored the domains originally developed by Charlotte Danielson so he adapted a learning rubric to reflect these growth areas to use as a cornerstone for professional development.

Added to these diverse challenges, Mr. L. is also currently working on several other major tasks for the next and following schools. Phase two of the 1:1 iPad initiative is to get a mobile digital device in the hands of all students. This phase is expected to begin next school year, where at least one high school grade level, probably ninth grade, will be issued iPad tablets for individual use. The plan going forward is to continue to add machines for each successive year for the same grade level, expanding use from one class, to two, and so on until the goal of 1:1 is achieved. The plan was somewhat unclear at the time of our meeting as to whether the initiative will involve only high school students, or be expanded to lower grades over time, but it seems Mr. L. likes the idea of full integration at least in grades 7-12, with a different, perhaps classroom-based 1:1 initiative for the primary and intermediate grades. That portion of the plan was not shared at the time of our meeting, but Mr. L. stated that the topic was still being discussed. In addition to the 1:1 phase 2, He is looking at different access areas, like the agriculture bus, and access for evaluation software in different areas of the school.

The most pressing business for Mr. L., was to retool the existing wireless internet structure of the district. All of the people I spoke to in the district, from faculty to superintendent, voiced a concern with the quality and reliability of the wireless and internet access. Mr. L. was embroiled in what sounded like a frustrating and challenging campaign to address major infrastructure issues resulting from myriad factors related to

the original installation and maintenance of the wireless system, and the seeming incompatibility of modern technology infrastructure to work with aging buildings and other systems. He identified this as the greatest challenge in his job at this point. He admitted that as the teachers use technology more and more frequently, weaknesses in the technological infrastructure become more apparent and create more problems. He alludes to a very expensive next step, in which the existing Internet and wireless systems may need to be dismantled completely, and a new system built in its place. He acknowledges this as the greatest issue currently impeding further development of district digital integration goals.

The overcoming of barriers is a key question of this study, and it would seem that the overcoming of barriers is paramount to this job. Mr. L. is charged with both increasing the educational digital integration of the school, while at the same time, dealing with the infrastructure issues posed in the school. If these issues were not addressed, the ripple effect would be felt out to the individual classrooms trying to integrate more technology, especially through the wireless devices that are the cornerstone of the district's integration plan. He understands the school culture and contributes to it in positive ways by leveraging a new component of the system itself to further allow the district to continue to move forward.

Technology Integration Specialist / Intermediate School Principal

Currently in his first year as principal at one of the two intermediate schools in the district, Mr. D is a district leader in the development of technology integration. Prior to the 2012-13 school year, he worked as a district integration specialist on special assignment. His job was to help people district wide to better use the digital tools at their

disposal, and to learn how to appropriately and effectively fold those strategies into quality instruction. He helped the district move to Google Apps for Education a few years ago, and was an important part of the SMART board initiative that the district implemented in the three years before.

Mr. D. is a classroom teacher by trade with a deep understanding of quality instruction and how digital instruction can enhance classroom learning. He was identified by the secondary principal and the district superintendent as a leader among the teaching corps in technology integration. He was promoted to a TOSA (teacher on special assignment) position as integration specialist three years prior, and was, until the hiring of the District Technology Coordinator, one of the key voices in the district regarding digital technology.

In 2012, he was hired as the principal of the intermediate school, where he previously taught. While his overall responsibilities have changed as a result of the hiring of the District Technology Coordinator and his promotion to building principal, he is still an important voice in the culture of innovation. He continues to be involved in many of the decisions in the district, particularly those regarding SMART board software and related applications, as he is known as a district expert in this area. As a building administrator with a strong technology background, he brings that much more spirit of innovation to an administration team with great desire to increase technology use.

Mr. D. also is part of a cooperative of districts collectively known as the Innovation Zone, which shares resources, strategies, and people with each district, and in connection with Minnesota State University in Mankato, MN. The group hosts a technology training forum at the university each year, and teachers and administrators

from each of the connected school districts are invited to attend. Mr. D. is a key coordinator of this workshop, and spends a great deal of time during the summer trying to bring different teachers from his school and those from other districts in hopes they may learn together and bring new ideas back to their peers.

Mr. D. was crucial in helping the school and district advance the innovation plans in previous years. In this example, it is hard to determine where the success came from, the man or the position. In either case, his role in the district addresses the research question regarding the swift evolution of digital technologies. His influences are seen in many areas of the school. His tenure as integration specialist was a key component in building the trust necessary for the staff to incorporate digital technology in the classrooms. This person and position certainly helped bridge barriers as teachers began to experiment and become proficient in digital education practices.

Secondary Principal

Dr. P., a mid-career principal has been at the school for just under twenty years, first as a social-studies teacher, and eventually as principal of the junior and senior high school building. He describes his primary role as an instructional leader, and explains that school leaders in this district are expected to be leaders in technology. He sees his involvement with the district technology committee a crucial part of his job as a leader. He sees technology as an important component in all instruction, and feels it important to not only be involved in the decisions, but to inspire and guide.

To the outside observer, Dr. P. appears to be well liked and respected in his position. His leadership style is very hands-on, and he can easily describe how the individual teachers and other staff in his building advance the district goals in the

classroom. He is an active part of the development of his teachers, and to this observer, conveys a strong interest in the implementation of digital technology in instruction. Like the technology coordinator, he takes a proactive approach to helping teachers meet their individual goals of instituting innovative strategies in their particular learning environments.

His philosophy toward digital integration is rooted, in part, in the administration team's reading of several books related to digital innovation some years back. He shared that the administration team decided almost five years before to read and discuss *The World is Flat* by Thomas L. Friedman and *Disrupting Class* by Clayton Christensen, Curtis Johnson, and Michael Horn, among others. This cooperative reading and discussion lead the team to consider forming a more ambitious vision for the district regarding digital innovation and progressive instructional methods. He detailed his feeling that this was a key event in the development of the district's culture of innovation. Together, the administration team (including technology leaders), formed what he referred to as a digital learning plan, which is an overarching vision of instruction rooted in the implementation of digital devices and other digital strategies for learning. An example of a discussion the administration team was having in this regard during the time of my study was the future of computer labs. Questions he posed were: will they still be necessary once the 1:1 tablet initiative is in place? If so, how many? These kinds of discussions have allowed him to help his building staff evolve and create new learning opportunities for the school's students.

He explains that one major advantage his school has is that they employ extremely curious, forward-minded teachers. He was unable to identify faculty members

who were completely resistant to the attempts by administration to promote digital innovation. He feels that every one of his teachers is open to improving instruction with technology, the only difference is initial level of understanding. He appreciates the fact that he has teachers in nearly every department who are positive peer leaders in technology integration, and teachers who desire more support in trying new strategies and feel comfortable seeking out support on a peer level. He stated that this is one of the greatest strengths of his building. In addition to peer support, he seems very confident in the ability of his technology support staff, and openly touts their ability to address the needs of his teachers well, despite the problems the building staff is experiencing with internet reliability and access. While he feels this is the biggest issue they face at present, he acknowledges it as a growing pain borne of teachers who are often ahead of the district's already ambitious vision for technology innovation. He said that he feels the self-assessments helped greatly in the identification of personal strengths and needs for the staff as a whole and for individuals, and the use of the survey and resulting digital integration evaluations helps to express to the staff that the digital vision in the district is a shared vision, and that the school is better for it.

At the building level, the secondary principal is a key component of all of the strongest strategies seen in the 7-12 building. The research question asks what systemic changes promote a greater acceptance of new digital techniques among faculty and administration, and Dr. P.'s leadership is, in itself, the systemic change, or catalyst for most of what was observed in this case. The choice of this leader, and the development of his skills was an essential element in the promotion and acceptance of new digital techniques.

District Superintendent

At first glance, Dr. O., the district's longtime superintendent would not likely strike many as an administrator who would embrace digital integration at a high level. He is a late-career administrator who has been both building principal and superintendent for over three decades. Though his work in the district spans a great length of time, his interest in becoming a leading district in innovation has evolved more recently. He also recalls the reading of the books *The World is Flat* (2007), a detailed study on how different society is in today's digital world, and *Disrupting Class* (2009), a groundbreaking look at how digital technology is impacting education, as a turning point in the administrative vision for the district. It was then that he became much more interested in developing the kind of innovation that would drive positive student learning and empower faculty to innovate in creative ways.

Dr. O. identified three main roles in his position as district superintendent. One is to transform the way they teach and learn in the district. The second is to engage students in ways they best connect. The third is to bring the students 21st century skills and information. These three goals guide him in the decisions he makes, and creates a quick litmus test for new initiatives. He was quick to point out, however, that the vision for the district is not his alone, but a very collaborative vision formed by constant visiting and listening to administration, teachers, students and parents. He feels the district is a perfect size for his vision; he feels they are large enough to warrant major initiatives, yet have a streamlined administrative structure, allowing them to make decisions and act upon them quickly. He mentioned being nimble as a school system is a strength which allows for many of the initiatives the district has undertaken.

During our discussion, Dr. O. made several telling comments that seem to go to the core of his philosophy. One he repeated three times, was "standing at the edge, looking over." He used this to describe a general vision as well as two different specific initiatives (iPads, and flipped classroom). Another he used was "building the plane in the air." He likes, even embraces, the idea that the district is nimble enough to be able to be on the leading edge of innovation, and confident that they can institute major changes in stride, with little precursor. One example of this is the iPad initiative. He stated that the iPads were in the hands of the teachers before they had had any specific training. He felt it important to allow the staff to learn while experimenting, and feels there are benefits to encouraging the staff to try new things and then evaluate and share them with administration and peers. A third phrase he mentioned is "getting the people in the right seats and the bus in the right direction," a direct reference to Collins' *Good to Great* (2001). He shared that the personnel he has working in the district seem to him to be in the right seats, and the bus is moving forward well. It is important to note that the other administrators made references to the bus analogy as well.

Two employees, while visiting informally, mentioned that Dr. O. had never heard of an initiative he didn't like, which was said with a mixture of sarcasm and appreciation. It seemed to me that the feeling among some in the district is that the goals and vision are valuable, but the manner in which ideas are deployed is somewhat chaotic and uncomfortable for some. When asked of this, Dr. O. smiled and explained confidently that in order to move swiftly in innovation, the district is often asking staff to move out of their comfort zones and try things differently, but then recalls the fact that he values the evolution of ideas borne from experimentation. He admits he likes initiatives because

they streamline disparate ideas and unify people toward a common goal.

All of the research questions are addressed in the observations of the superintendent. The interview with Dr. O., as well as the references others in the district have made of him, suggest that he is the incitement of the culture of innovation in the school and district. His vision and interest in digital innovation creates system-wide acceptance and support, and as an active leader, the support for individual and building initiatives is seen as generally positive. He is personally involved in identifying barriers that keep people or other parts of the system from moving the vision forward, and is actively involved in the solving of these problems. As an active rather than passive leader regarding technology, the superintendent sets the tone and vision, and challenges others to keep pace.

Summary

This chapter presents several examples of people, situations, and interactions that helped to answer the research questions. The information was offered in small vignettes that highlighted some of what is happening in regard to digital integration in the district, particularly in the secondary building. In the next chapter, overall interpretations and conclusions will be discussed, as well as implications that these findings provide for educator, school, and district-wide practices.

Chapter V

Discussion and conclusion

The findings and conclusions derived from this case study are revealing. The observations of what happens in one district, in one demographic and geographic environment, can be largely instructive. Of real importance is the identification of certain aspects which, when observed in other environments, can begin to build a core of best practices. The literature on educational best practices is certainly rich with examples, philosophy and specific research. However, these need to be observed in actual districts, actual schools, and actual classrooms for validation. What follows are some such validations, and some further questions for future research. The key questions that framed this study were:

1. What are the strategies and/or norms that allow for this school district to evolve swiftly and appropriately in regard to digital technology in instruction and education?
2. What systemic changes promoted a greater acceptance of new digital techniques among faculty and administration?
3. What digital uses or strategies are showing the most success or promise in this school district?
4. What barriers were present in this case that impeded the innovation of new digital technologies, strategies, or philosophies?
5. What does the district in this case do differently to overcome said barriers?

The observations and information gained during this study have addressed these with some clear qualitative data. The discussion and conclusions that follow will shed

further light on the results of the study.

In order to best understand the results of this study, it is important to address each of the research questions in turn, examine what was observed, and begin to try to understand why it is important.

Strategies and Norms that Allow this District to Evolve Swiftly

Part of what makes this district able to attain goals of swift and appropriate digital technology integration are some specific strategies, which clearly promote the vision of the district.

Professional development was a key factor in my observation. Several school leaders discussed the importance of training and development of staff. While this is hardly uncommon, the leadership makes professional development regarding technology integration a primary goal. They saw effective instruction and technology integration as one and the same, rather than disparate ideas. For example, a self-evaluation (appendix yes include this evaluation) was used with staff to help them identify strengths and weaknesses in their instruction. The rubric does not pertain to specific tools or strategies related to digital technology, it is instead based loosely on Charlotte Danielson's *Framework for Professional Practice*, and adapted by the technology coordinator. The rubric uses these domains to identify how an integrated approach would appear in the classroom. Teachers are asked to evaluate themselves based on a scale ranging from novice to distinguished. The message in this evaluation is clear. Not only is integrating digital technology important to the district, but the district also does not see a distinction between quality instruction and integrated instruction. By asking good teachers to evaluate whether they feel they are effective teachers in this frame, challenges everyone

to see integration as a required skill in quality teaching, not simply an addition.

Effective integration of digital technology. In the high school, all teachers are evaluated three times. At least one of these evaluations must be of a clearly defined digitally-integrated lesson that is aligned with one or more of the goals of the rubric qualities. As it is expected of all teachers, it has many different influences. To the early adopters and most innovative faculty, it allows them a chance to showcase and display new strategies and tools. For the novices, it enables them to seek support and instruction in advance of the lesson, and for the rest, it allows them to engage in dialogue with administration about the individual's own accomplishments and frustrations in their own efforts to digitally integrate.

There are many other positive influences. Mr. L. explained that it allows the support staff to better understand the needs of the faculty. By having intimate conversations about how the integration was approached, how often lessons involve integration, and what new strategies are being considered, it allows support staff to anticipate needs for larger scale professional development, while also identifying individual needs, like equipment upgrades or service. These evaluations also continue the vision by the administration that integration of digital technology is important. It seems to allow for a dialogue on the subject, which would result in the strengthening of the vision of the district among the individual faculty members.

Increasing connectedness of the staff and administration is also a key to meeting its goals. Using Twitter as a platform for public communication is popular among the administration and faculty. All of the administrators used the social network, and some used it hourly. This allows for the administration to positively highlight the

work that is being done in the school or district by the staff and students in real time. This public recognition appears to help advance the goals of the school and district in a non-confrontational, positive way. The high school principal tweets out positives from evaluations, effective strategies, faculty successes, student successes, new innovations, and general compliments. In response, he has among his followers dozens of district employees, many students, and, I presume, parents as well. Since this is a public forum, these accolades are not simply viewed on a bulletin board in the school commons, but displayed for the world to see. Most of the administrators and teachers who use Twitter professionally have followers who are not directly associated with the district. It would be assumed by many of the recipients of these positive tweets that they are displayed beyond the reach of the school culture. I believe people outside the district follow those within it for inspiration and understanding of what is being done well.

Using Twitter in this way also allows the various entities in the district to all be aware of the same things. By tweeting the use of Sentio machines in Mr. K's class, for example, all of the members of the administration team and many of the faculty become aware. This networking speeds up innovation by quickly highlighting successes so that others can build upon them, research them, or discuss them. The benefits of this are universal in the school culture, but it seems to have a particular impact on the implementation of digital technology.

Not only are teachers and school leaders learning from each other, but the network allows them to learn and collaborate with others in the world. Dr. P. mentions his Twitter network as being a rich source of ideas and strategies from around the world, resources they would not have access to if he were not a user of this platform. He draws

upon the experiences and materials from other school leaders, teachers, technology experts to continue to infuse new ideas into the school culture.

In addition to Twitter, many of the teachers wrote blogs about their practice, and most kept a district-provided web page to connect with students and parents. The multiple levels of digital communication is a notable strategy in swiftly innovating best educational practices, and this district seems to leverage it better than most.

Group research. The administration regularly reads or researches together, that is, they each read selected materials and then they follow up with deep dialogue. This appears to be the medium that has lead to the inception of core beliefs held by the administration, and which are communicated to other stakeholders in the district. Each of the administrators I visited with mentioned titles of books and other materials they had read together, that lead to valuable dialogue which informed systemic strategies. Some titles that were mentioned in my discussions were *The World is Flat (2007), Disrupting Class (2009)*, *and Good to Great (2001) by Jim Collins.* What is truly remarkable, is that in visiting with other school staff and administrators, I clearly saw and heard philosophical references to concepts these books discussed. One teacher and two administrators verbalized the belief that the staff all seems to be in the right seats going the same direction, a likely allusion to Collins' bus analogy, which suggests managers get the right people on the bus, and everybody in the right seats (p.13).

Others frequently used terminology like disruption and evolution, both key themes to *Disrupting Class*. Global competition came up in two different conversations as well, an allusion to Friedman's thesis in *The World is Flat*. These comments are certainly part of the educational culture in America, and may not correlate directly to the books

administrators read and conversations that followed them, but it was quite interesting to hear these books later mentioned as key readings shared by administration. It seems possible, even likely that some of the shared reading activities had such profound effects on the school leaders, that the concepts therein assimilated into the school culture without being deliberately done so.

Whatever the impetus, I observed a very clear vision among the school leaders for the implementation of digital technology in the educational practices of the school and district, that was fairly well understood among administration, support staff, and faculty.

Systemic Changes Promoting Greater Acceptance of Digital Techniques

Positive collective attitude. Every educator and administrator I visited with could easily describe how they used digital technology for increased student learning. Each person had a different skill set and interest level regarding educational technology, yet it was clear that part of the building culture was to be aware of the existence of digital tools and strategies, and to attempt to implement them as necessary and appropriate.

Several levels of leadership. One systemic change that seems to have been very important in this case was the establishment of multiple levels of leadership centered around the positive implementation of education technology. It was clear in visiting with the superintendent, that the secondary principal's esteem for innovation and his ability to share why he values innovation, was a large part of the school's success.

The designation of teachers on special assignment (TOSA) for the specific purpose of helping staff learn how to better implement digital technology was another key step in helping to break through the mystique and perceived difficulty in doing so. The previous TOSA, Mr. D., was instrumental to helping secondary staff identify areas of

possible improvement through improved instruction, which includes leveraging digital technology. He seemed to be a great catalyst in helping the uninitiated to embrace the progressive shift toward technology-rich instruction.

District-level technology coordinator. The addition of this position was another key change. It allowed the district to both share vision and collect data more efficiently. The addition of this level of administration does not appear to have created an abundance of additional bureaucracy, but rather, at least in this case, a chief of resources. By assigning a head to the department, the district was able to meld the talents of IT professionals, instructional coaches, and faculty technology users into a more collaborative group. He also seemed to bring a great deal of content knowledge in the area of professional development, which appeared to make immediate impact on teachers.

Shared vision. The fact that all of the administrators followed the same vision of digital implementation, and enthusiastically so, was a key to what appeared to be a nimble system of continuous growth in this area, as opposed to isolated initiatives which may not have had the same level of cohesion without the common threads of vision.

It was also clear that the leadership makes a concerted effort to highlight, praise, and share positive examples of the digital innovation teachers use in the classroom. It seemed that most of the educators in this building were glad to share what they have been trying to accomplish in their classrooms, and were not shy or timid in describing successes or failures. This might be expected among a few staff members, but that many educators from diverse fields of study and in different stages in their career all tended to be forthcoming and generally positive about the types of implementation I asked them

about. I got the impression that the educators I spoke with were proud to share what they have been able to accomplish in their classroom.

Minimum of active resistance. In my own professional experience, it has been clear that teachers in other schools are not always so willing to share successes and failures, especially in the realm of education technology. Educators in schools I have worked in or worked with have often been reluctant, defiant, or even cavalier in their attitudes regarding implementation of technology. I did not meet anyone in this building who seemed in any way oppositional toward the general culture of innovation. What was present with three educators in particular, were specific concerns about clearly defined areas of the plan, rather than the plan itself. I found this to be notable, both in the way the educators seemed to retain a positive attitude to the larger vision of the school in regard to digital technology, and in the comfort they felt in critiquing particular aspects of it. One might expect to find at least a few people who, due to a range of objections and concerns, may have had an negative view of the direction the school was moving, but no one in particular was mentioned or observed.

When asked, neither the technology coordinator nor the secondary principal could name a particularly obstinate or negative staff member in regards to the technology vision of the school. Both indicated that while there were many staff members at different places on the implementation spectrum, yet all of them appeared to be willing to accept support and move forward in implementing relevant educational technology. Dr. P., the building principal, was also unable to identify a faculty member who was actively resistant to the implementation of digital technology. Administrators seem to genuinely appreciate any attempts at trying new things, and encourage experimentation with

relevant educational technology.

Modeling of the desired behavior. I believe this positive attitude toward the initiatives put forth is also due, in large part, to the administration. The administrators are all confident and skilled technology users. They each carry an iPad everywhere they go, and use digital means rather than paper or traditional means for communication whenever possible. This modeling is a key difference at this school compared to other schools where administrators may be the most reluctant users of technology. When administrators truly embrace both the technology, the staff has a clear view of expected behavior.

Furthermore, it seemed clear that there was effective peer modeling as well. Early adopters of certain digital technologies were able to easily recount times when they had been asked questions about the technology in question. This suggests that there is an open dialogue present among the staff that allows for easy sharing of techniques and ideas, and the implementation of digital technology appears to be one of those areas. I expect this openness and collegiality pays dividends in many other areas, but it was evident that the staff expects to share successes and failures regarding technology, and even look forward to doing so.

Openness to dialogue. Open communication stood out in this study. One department, the world language department, seemed to involve several instructors independently creating content and individual strategies, while engaging in frequent conversations comparing and contrasting the individual approach. I believe similar conversations happened in at least two other departments in the building: Language Arts and Mathematics. This seems to be a key difference in this school compared to others I have been involved with. Whether that is something that can be clearly attributed to

leadership isn't completely clear, but I did see the same types of dialogue happening among the staff that I did among the administrators. In any case, it is clear that open dialogue is both valued and leveraged as a very positive aspect within this school culture.

Digital Uses or Strategies Showing the Most Success or Promise

Several digital uses were observed in this school district, particularly in the secondary building, but the primary areas of use tended to fall into the categories of effective use of the Internet, use of digital devices, and electronic communication.

Competent, regular users of the Internet. Educators I observed regularly used the Internet for instruction classroom management. Language Arts teachers were using tools such as Google Apps for Education to connect student writing in a live setting. These teachers shared a document with each student and had live access to the essay writing that students were creating. This allows the teachers to offer frequent feedback and guidance to the young writers. Furthermore, one of the teachers explained how using web-based voice and blog creation allows students to better share what they know with others. The tools used for these sites are easy to access and use online, and provide great opportunities for further learning.

In the agriculture classroom, the instructor used Evernote for much the same purpose. Students in this class shared assignments and relevant materials through the cloud-based website, and the instructor was able to collaborate and assess the learning of the students in real time. The Spanish teachers used video sharing sites like YouTube to share Spanish-language videos to students for better comprehension. They also utilized the Internet for pictures and other visual aids to aid student learning. The media specialist used cloud-based programs such as Infinite Campus and Google Apps to

manage materials and information, and these databases were connected with students, allowing for smooth connection between students and resources. The special education teacher accesses interactive learning games and instructional sites for the continuation and reinforcement of learning targets. Overall, it seemed clear that faculty were both aware of relevant online resources and willing to implement them as the opportunity arose.

Frequent users of mobile digital devices. District faculty and administration, particularly in the secondary building, utilized all manner of mobile digital devices. Each teacher in the district has at least one iPad to use, and every teacher I observed used it in one way or another.

For the Spanish teacher, it was to manage attendance while moving about the room. This teacher also used the device to easily check student work submitted in various forms online.

For the agriculture teacher, it was the primary computing device, and she used it several ways. The device held files and folders containing a majority of her lessons, plans, and materials. She also used it frequently to connect to the Internet to manage the classroom or access online information. She demonstrated how she used it and frequently uses it to connect to the large screen for display to the class. She also used it for evaluation, as students could share work and research. She could access such work on the device for review.

The building principal was observed carrying and using his iPad in all of his school interactions. He used the device to access student attendance and grades, to

communicate with staff and students, and to collect data and resources used as part of his school day.

The district superintendent likewise used his iPad as part of his daily routine for similar purposes. He explained using it was important not only because it allowed him mobile access to important information when away from his desk, but also to model its use for other staff.

Another digital device that was being used was the Sentio responder. This hand-held device is part of a pilot program in Mr. K's math classes, and he mentioned they were being tested in a few other classrooms around the district. The Sentio responder allows students to connect with material shown on the interactive white board, either by responding to questions and problems, or by doing self evaluation of what was previously learned. The device can also be used to respond to paper-based tests, and evaluated by the instructor on a computer elsewhere. He seemed very positive about the success and reception of Sentio's use in the classes.

Digital communication. The use and acceptance of digital communication was virtually universal, and could be seen in multiple ways throughout my interactions in the district.

Electronic mail (eMail) was used daily, even hourly by all staff. While this is hardly a breakthrough, it is notable that this form of digital communication was not replaced by other communication tools. In other words, eMail does not appear to be obsolete due to use of other communication methods.

Twitter was utilized daily by part of the staff. The actual number of users was difficult to determine, but it was clear that the administration team used this for

communication frequently, and it seemed as if at least a moderate number of faculty were involved through Twitter as well. The secondary principal seemed to use this format the most, sending messages relating to faculty successes, building notices, student appreciation, and direct messages to staff and students.

Online student connection. All of the teachers observed used some sort of online connection to students. For some, it was Moodle, an interactive classroom connection. Others created websites in order to share information and materials with students, still others used classroom blogs or wikis to communicate and collaborate. The formats varied, but all of the faculty used at least one, and in some cases several online connection strategies to offer an extension of the traditional classroom constraints. It was clear that this was an area of strength among the faculty. The former technology integration specialist (now elementary principal) explained that the district provided websites for all staff some time ago, but many staff found other ways to do the things the faculty websites were meant to employ. He also shared that the use of an online connection was not explicitly required of faculty, but nevertheless expected. It seems that this is an area where the initial request for staff to integrate technology was met and in many cases exceeded by staff.

The existence and use of technology itself is not particularly notable in any school without the concept of integration. The digitally integrated classroom (or school) does not see education and technology as separate entities, but as intertwined and inter-related symbiotic relationships that help learning happen. It was easy to see examples of this integration in every classroom I visited. The assistive technology in the special education department, the rich visuals and other material in the language classes, the interactivity in

the math classes were all integrated into the larger learning goals of the classes. There seemed to be no specific distinction between digital lessons and traditional lessons, it was all one. In the agriculture classroom it is difficult to determine what is traditional instruction and what is digital instruction. There is a smooth flow between instructional techniques that transcends category. Most of the classes I observed in this district operated in a similar manner.

Barriers Present that Impede Digital Innovation

There were several barriers present in the school and district that could be easily identified impeding innovation. Many were known and addressed differently, but they were still present, or at least have been present at one time.

Digital divide. There is, by the accounts of several people in the district, a digital divide present in the district. The media specialist discussed the need for checkout machines because there were students in the school who had limited or zero access to computer technology. He explained that the checkout laptops were being heavily used, indicating that there was a need for more of them. It was unclear in my visits whether there was clear data present in the district as to the percent of students who did not have home computer access, but such data is likely to have been recorded at some point. Regardless, few of the staff or administration spent a lot of time discussing the percentage of students without access.

Resistance to change. Another common issue in schools is resistance to change. While the concept is hardly new, the manifestation of resistance as a barrier to technology use is notable in most cases, but was not directly observed here. In such an innovation-minded environment, it might be expected that the level of resistance would,

at least among some faculty, be notable. At least initially, many schools who push innovative changes face faculty backlash or resistance. This was not observed in the secondary building, nor was it ever mentioned as a major barrier. Administrators did discuss the growing pains that the school staff experienced, and many staff alluded to individual complaints about how things might have been handled, but there was no mention of active defiance or resistance by staff or students. This, of course, does not mean there was none. It could mean that the dissent is silent and possibly very individualized, or it could indicate that my observations were not structured in a way to invite discussions about deep dissent.

Internet bandwidth and wireless access. As infrastructure problems became a major theme in my discussions with staff and administration, it highlighted a common problem in many public schools. As technology advances, schools often struggle to keep pace with aging buildings and infrastructure. Mr. L. explained that the problems his school were dealing with were not unlike the many other schools he has worked with in the past. Internet bandwidth and positional wireless access within buildings and classrooms are barriers that create major weaknesses in digital integration, and they are difficult and expensive to address.

Funding. The superintendent discussed asset allocation, a key component of this issue. It became clear that the way a school allocates financial resources directly related to the strength of the infrastructure. Considering the relative commonness of funding crises in Minnesota schools, it stands to reason that funding issues in districts hinders the amelioration of digital infrastructure problems.

Faculty-level innovation. The general success of teachers in piloting and driving

innovation in schools seems to also create issues. In this school, it was observed that many faculty members were advancing the technology in their classes beyond the capacity of the school support system to keep pace. This creates two distinct problems: The first is the additional pressure on the support staff, which in turn creates pressure on administrators to improve infrastructure. The second is a reflexive frustration by early adopters, which eventually may have a dampening effect on the innovative culture. Further research may well show that it is the early adopters who both drive change and create disruption to the school culture by stretching resources and infrastructure to the point that it either creates an evolutionary leap forward, which I believe is happening in this school, or could create a devolution and additional resistance to the innovation of digital technology in innovation. It's possible that by finding the barrier of what can be done, and being then either satisfied or not, teachers might refrain from further endeavor. I presume that examples of both situations could be easily observed in other public schools, but further research will certainly be needed to understand this dynamic.

What this District does Differently to Address Possible Barriers

This district is not perfect, and they would agree. They face the same or similar barriers that might be expected in many other public schools. They have, however, seemed to address these barriers in effective ways. The ways in which they have addressed these barriers would seem replicable in other school districts. While barriers and successes in innovating with digital technology will always be unique to the individual school district or school, some of the principles at the heart of this case would be relevant in other situations.

Culture of innovation The key difference in this school, unlike many others I

have experienced, is that the district exhibits a culture of innovation. If "culture" is the way we live or the way we do things, then there certainly is a correlation here. Technology is simply how they educate students in this district. It was easily and casually observed in all areas of the school, including with all the staff, from the superintendent to the office staff, to the teachers, coaches, and other support staff, and, not the least, the students. The district has formed this culture by doing several things differently, and most of what they do differently comes from leadership at various levels.

The superintendent was very clear in his appraisals of this culture shift. Inspired by new readings on the subject of education in the coming century, he and other administrators began to consciously outline a pathway for the district to catch up to the fast-moving world. This mindset has influenced a majority of the people working in the district, and has in turn influenced the students. The district's nimbleness, as described by the superintendent, is a major advantage. He described the district as having a minimum of administrative entities. Within the school leadership, there is a great deal of trust.

Leaders engage in true dialogue. They are able to be more effective together than as individuals. Individual leadership decisions are then made in a comfort zone of common and shared vision. Since all school leaders in the district believe it is not simply an advantage for schools to be technologically integrated, but is an imperative for survival, motivation is authentic. The school leaders in this district see innovation as a life-blood, not simply an enhancement. They see no other way but to march boldly forward into new technological integrations because to not do so is seen as dangerous. This philosophy is both defensible with current research, and is relatively easy for others to understand. When educators can clearly see the schism between the traditional school

model and the reality of the modern information age in society, it is easy to take the leaps of faith necessary to reform education as a digitally integrated innovation machine. The superintendent and other school leaders keep the bureaucracy at a minimum so that the district can evolve swiftly and effectively.

Educational funding. Perhaps the most common single problem in public schools is met with a different vision in this district. Since the underlying philosophy among the school leaders, and by extension, the entire staff, requires financial investment, the funding allocation must be a part of any initiative. The superintendent has made clear that innovation is a priority, and answers this in thought and deed. One approach has been the understanding that commitment to innovation also means parting with outdated strategies and materials. As such, he explains that many of the funding issues have been alleviated by shifting funds from areas that do not advance the innovative vision to ones that do. One instance we discussed was textbooks. The textbook expenditure is slowly declining, while investment in digital resources is increasing. School spaces once meant to house books, are becoming spaces to add computers. In a 1:1 environment, these spaces may evolve again for different uses.

The district believes that digital technology can in many ways replace outmoded materials and other expenditures, and their recent experiences have supported this philosophy. The culture of innovation also seeps into the community, who are able to see visible changes in the district as producing philosophically sound innovations, and therefore are more willing to consider school funding initiatives as positive. Dr. O. also mentioned grant-writing as a solution that was readily embraced by his staff. By making the advancement of digital integration a prime constituent of the school philosophy, it

sends a message that not only reaffirms the core vision, but communicates the needs of the school in such a way that the funding trials can be addressed as a necessity.

Conclusions

The prevailing recent literature offers many examples and discussion on what Senge (2006) described as systemic or shared vision. (p. 9). In this case, the district leadership models this understanding in several ways.

Active dialogue. Leaders in this district engage in active dialogue, which Senge highlights as a key component to a learning organization (p. 5). The result of this dialogue is a fuller understanding of the necessary steps to achieve the goals of the district. In this case, a primary goal is to innovate with digital technology integration. This has become a clear vision for the administrators and most of the faculty of the school district.

Effective professional development was also a key to the successes shared within this district, and there is much to indicate that effective implementation of digital technology is dependent on such development. Professional development in this district went beyond the typical occasional training, allowing for continuous improvement and understanding among faculty members. The administration owned the responsibility to both allow for learning of faculty, but also for the positive reinforcement of peer learning and leading. The district makes clear that *how* learning technology is done is far less important than *that* it is happening. There is a certain freedom and trust that has developed among the staff, and that has allowed for a high level of intrinsic motivation.

Culture and climate. Building school culture is commonly referenced in educational research, and there is a very clear school culture in this district. It is derived

from a combination of the priorities and expectations of school leaders, and from the intrinsic motivations of many of the members of the staff. I believe school culture is the commonness of beliefs that shape how the stakeholders operate in the school. In my observations, the culture could be best described as progressive and innovative.

Carefully chosen personnel. It is crucial to highlight that the addition of the right fit in personnel largely influenced the success of the vision in the district, and has allowed for typical barriers to have been anticipated and addressed effectively. Since the vision is clear, especially among administrators, it becomes part of the hiring protocol, and the response on staff becomes easier each year because the administration seeks potential employees who embody an interest in innovation and technology.

Implications for Public Schools

There appears to be two distinct tracks emerging on how school reform must be carried out. One, based on governmental standards, is already well established and continues to have great impact on public schools. This reform model was precipitated by No Child Left Behind, and has given way to such initiatives as The Common Core, Race to the Top, and other standards-based initiatives. These initiatives make learning a job with a result, such as a high-stakes test. This form of school reform approach is faulty in many ways. The focus on the result, rather than the process, suggests to students and teachers that teaching to the test, to the standard strands, to the script, is the appropriate way to survive the learning experience.

The second approach to school reform is very different. Born from those who look at education as a component of society, not simply as a job, 21st century education and the reforms that are suggested by this approach see education as an evolutionary

construct that must keep pace with the society in general, and makes no promises that traditional models of education will be retained. The progressive, or 21st century education approach, seeks to find authentic learning by utilizing the tools and strategies that will best assist students. This often includes an integration of technology and the melding of nontraditional educational strategies such a project-based inquiry, experimental education, and student-centered education. Proponents of this general approach to education have been vocal, and the research suggesting widespread success in schools who adopt this approach is abundant. High-profile, well-respected education experts such as Diane Ravitch, Sir Ken Robinson, Marc Prensky, Scott McLeod, Deborah Meier, Yong Zhao, Daniel Pink and many others have openly called for school reform that pushes away from the standards-based approach in order to embrace 21st century skills and innovative, creative education models. While this second approach is far more popular among educators and produces far more compelling research, it remains unpopular with the bureaucratic system of education present in public schools. As a result, schools are asked to build education into a system that produces data; data which can be used to evaluate students, teachers, schools–even parents. The focus on producing this data instigates dubious motivation for teaching and learning. It motivates in a much different way than the intrinsic, discovery-based motivation at the core of 21st century education. The drive for results teaches all who are involved, that the end result far outweighs the process of learning.

The current situation is that American public schools are imprisoned in expectations derived from the standards-based dynamic, yet many see the benefits of the 21st century educational approach. I believe some schools are finding very effective ways

to exist within the constraints of governmental control of curricula while pursuing the promise of 21st century education. The school in this case is a good example of this kind of approach. In this district the standards are not ignored or disrespected. They cannot be ignored, for they are mandated as part of the covenant between the state and the district. This school pursues many of the standards-based approaches necessary for a school to legitimize itself and keep pace with its peers and the rest of the state. Nevertheless, it does not build the school culture around standards, and that is what makes it different than many other public schools. I observed no mention of improving test scores or references to common core curriculum, or any such indications that the culture of the district was focused solely upon end results. Conversely, the superintendent himself explained that he has complete faith that pursuing a 21st century approach will have inherent benefit to test scores. While these scores are indeed still monitored, they are simply not the core of the culture. This district has instead created a culture of innovation. This culture promotes experimentation and collaboration, and the staff and administration share a desire to move forward as a district, not toward better test scores, but toward a richer educational experience. The superintendent explained that while the pressures from the state and federal government can be limiting, they can also inspire. He believes, and evidence of this could be observed throughout the district, that positive results will happen when students learn in a rich environment. This district's standardized test scores are well above the state averages, and lead in some areas of evaluation, even though the district discourages strategies that teach to the test. Instead, the culture of innovation creates myriad effective, differentiated ways for students to learn, and the results follow.

It may be easy to imagine that top-down leadership builds culture, but what is remarkable here is *how* it does so. The administration in this district became aware of a potential threat to traditional education by reading current books on the subject and discussing the facts put forth by them. They realized that the paradigm was shifting in the nation and world, and that if the district could not find ways to become nimble and promote evolution, the results would be catastrophic. The high school principal explained that during these book discussions, they realized the implications of what all of them had observed in society, and were able to isolate specific problems within the educational system that could easily contribute to a schism between what public school offered and what students would need to be successful in the changing society. This notion penetrated the vision of the district, and the leadership began to embrace the 21st Century approach to education, and decisions, perhaps even subconsciously, were made to hire staff who would be open to change, to train faculty to expect change. I realized that the phrase I heard from some of the faculty that the superintendent had "never heard of a new initiative he didn't like," was a result of this philosophy. The abundance of new initiatives helped to acclimate faculty to the culture of innovation.

Building this culture of innovation around the integration of digital technology and other 21st century skills allows this district to stay nimble and responsive, not simply to the whims of governmental entities, but to the needs of the students themselves. In a sense, the culture in this school is a challenge: how can we do what they say we should in the way we believe to be the most appropriate and effective? This challenge is met successfully by a large group of faculty and the administration team.

Public schools wishing to build a similar culture of innovation based on 21st century skills and digital integration must build a shared vision of success based on the following directives:

1. Refocus administration entities around collaboration and research, not control. School leaders need to be the most knowledgeable in the district on the state of education and the 21st century reform philosophy. They also need to see their role as inspiration, not management alone. The key to building this kind of culture is not about linear hierarchy, but collaboration.
2. Empower faculty. The strength of the culture of innovation is in the faculty. When faculty are accustomed to the idea that experimentation is good, that collaboration is important, that piloting new technologies or strategies is expected, it opens up the culture to allow for authentic action research and development of best practices.
3. Focus on development as a process not a goal. Faculty need to understand that effective teaching will change frequently to keep the pace of a changing society. The technology that is being used will certainly change or be replaced. Work toward the goal of educators seeing learning as an ever-changing landscape, rather than a skill to master is crucial. This culture values how we learn just as much, perhaps more, than what we have learned. It helps students to see that the information itself may become obsolete, but the learning process will always be paramount to success. When students understand the process of learning, understand the tools that can be utilized, and can leverage information instead of just memorizing it, knowledge becomes a transformative experience.

4. Embrace digital technology, not just the digital tool. The school in this case endeavored to keep the focus on understanding the potential for digital tools and strategies, without becoming enamored with one singular device or platform. For instance, while the district is investing heavily in Apple iPads as a 1:1 initiative, the superintendent is quick to point out that these devices are what they are using now. He makes clear that the device does not limit their scope or vision, and that they are ready for this initiative to evolve into a completely different use of digital technology in the future.
5. Address governmental standards as challenges to innovate, not to remain grounded. The standards expected of schools can be reconciled in the 21st century because at the very essence of the standards-based structure remains a vision for what is best for students. While these philosophies may have specific incongruities, there exists ways to remain faithful to the standards required and the evolution desired. The implementation of digital technology can be leveraged in order to meet goals in ways that still value the process of learning in the 21st century.

Recommendations for Further Research

There are many opportunities for important research in this area. There are a lot of studies about how and why schools should integrate technology, but very little that connects the integration of digital technology with overall learning. The anecdotal stories that exist suggest a compelling connection between digitally rich learning environments, but more quantitative research must be done to further solidify the notion that digital technology is an important aspect to learning. Clearly, this case study needs to be

replicated in many more schools. Researchers should continue to note the personal connections and describe the leadership philosophies among principals and other school administrators that best allow for the swift and effective integration of digital technology. This case hinged on a specific mindset among the school leadership that was particularly powerful. It would be valuable to find other such cases, and continue the study on how important the driving force of education leaders is in connection to 21st century school reform. I believe there are many such schools in America. Finding germane correlations between school leaders who possess this sense of evolution for survival in order to build a process they can access to overcome barriers and create new paradigms for school vision would be particularly beneficial.

Finally, it should be noted that while standards-based reforms come with tidy numbers and easy to aggregate data, the research that promotes these approaches to education is often very incomplete. There is a great need to pair qualitative study of these schools with the quantitative data that is derived from research into results-based systems. Researchers need to look beyond numbers to seek a better understanding of what is really effective in schools. If test data suggests approach X is the key to learning, then qualitative research must be done in order to tell the rest of the story. Such research may well suggest effective leadership, intelligent students, or a culture of success; or conversely, may suggest low morale among faculty, lowered expectations for creativity, limited collaboration, and so on. The data gained from quantitative studies in schools is valuable, but in the end, there will always be far more to the story than the numbers suggest. Researchers must continue to consider the value of qualitative study in order to validate or repudiate what the data suggests. It is the opinion of this researcher that

school districts that are making the greatest strides toward creating revolutionary learning environments will be more difficult to quantify. The real successes in these skills have to do with faculty relationships, leadership trust, philosophy, and the way that educators seek technology to help to meet learning goals. These are not easily researched quantitatively, but require that researchers investigate and tell the story so others can easily understand the successful components of innovative education.

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Appendix

Instructional Technology Integration Proficiency Rubric

Overall Technology Integration Proficiency

Novice	Adoption	Adaptation	Infusion	Transformation
The teacher is beginning to use technology tools to deliver curriculum content to students.	The teacher directs students in the conventional and procedural use of technology tools.	The teacher facilitates students in exploring and independently using technology tools.	The teacher provides the learning context and the students choose the technology tools to achieve the outcome.	The teacher encourages the innovative use of technology tools and technology tools are used to facilitate higher-order learning activities that may not have been possible without the use of technology.

Domain 1: Planning and Preparation

Element	Novice	Intermediate	Proficient	Distinguished
Matching Technology to Curriculum and Standards	Technology activities used in lessons are not aligned with one or more curriculum goals.	Technology activities used in lessons are partially aligned with one or more curriculum goals.	Technology activities used in lessons are aligned with one or more curriculum goals.	Technology activities used in lessons are strongly aligned with one or more curriculum goals.
Matching Technology to Student Abilities	Technology activities used in lessons are not developmentally appropriate for most of the students.	Technology activities used in lessons are not developmentally appropriate for some of the students.	Technology activities used in lessons are developmentally appropriate for most students and they enhance concept development.	Technology activities used in lessons are developmentally appropriate and they enhance and extend concept development promoting deep understanding.
Matching Technology to Higher-Order Thinking Skills	Technology activities used in lessons promote only lower-level thinking. (Remembering & Understanding)	Technology activities used in lessons promote mostly lower-level thinking.	Technology activities used in lessons promote some critical thinking. (Applying & Analyzing)	Technology activities used in lessons promote higher-order critical thinking. (Evaluating & Creating)

Domain 2: The Classroom Environment

Element	Novice	Intermediate	Proficient	Distinguished
Matching Technology to the Classroom Environment	Technology activities used in the classroom are mostly used as a reward or time-filler and are not used as a tool for specific learning objectives.	Technology activities used in the classroom are sometimes used as a reward or time-filler and are seldom used as a tool for specific learning objectives.	Technology activities used in the classroom are used as a tool for specific learning objectives.	Technology activities used in the classroom are strongly used as a tool for specific learning objectives.
Matching Technology Access to Classroom Lesson Activities	Students do not have equitable access to technology during lesson activities.	Most students have equitable access to technology during my lesson activities.	Most students have equal and appropriate access to technology during my lesson activities.	All students have equal and appropriate access to technology during my lesson activities.