Bridging the Gaps:

A Case Study on the Implementation of Educational Technologies in High Schools

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March 9, 2012

ACKNOWLEDGEMENTS

I would first like to thank my advisor, Barry Fishman, for his enduring patience, guidance, and support throughout this process. Although I did not know him when he agreed to be my advisor, he has been a constant source of wisdom and expertise for the past year and I have come to see him not only as a personal mentor, but also as a friend. Despite his busy schedule, he always made time to meet with me and I knew that I could count on him, every step of the way. He has been patient with my unending questions, encouraging during my moments of panic, and has given me the confidence that I needed to complete my first somewhat independent intellectual endeavor.

I would also like to thank Michael Heaney, the honors advisor for the Organizational Studies Department. Michael was the one who first encouraged me to undertake this daunting endeavor despite my initial reluctance. He has reminded me of deadlines, sent me articles on research strategies, suggested relevant organizational theories, and been a source of general intellectual support for the past year.

I would also like to acknowledge the Organizational Studies (OS) Department, specifically Denise Yekulis and Cathy Philbin, for facilitating this process, scheduling meetings, and helping me to locate the resources that I needed to successfully complete my thesis. I would also like to thank the OS department for the Honors Research Support Award, without which none of this would have been possible.

I am also grateful to my research participants, who will remain nameless for the sake of anonymity. They were willing to talk to me, answer follow-up questions, and help me navigate the process of gaining entry into the high school, which was no easy feat. Their insights and honesty gave me a window into the heart and soul of technology usage at this school, and I am very grateful to them for that.

Finally, I would like to thank my family and friends for listening to my complaints, assuring me that I would finish at some point, and lending me their advice and proofreading skills on more drafts than I can count. They were always there to cheer me on, and I know that I would not have been able to do it without them.

Although difficult at times, I am proud of what I have accomplished this year and grateful to all those who helped me along the way.

ABSTRACT

This study combines qualitative and quantitative analysis of interviews with teachers and technology staff at a high school in the Midwest in order to understand the organizational factors that affect the integration of educational technologies into the education system. Analysis of the interview transcriptions led to three major conclusions. The first is that educational technologies are often unreliable and difficult to learn, which discourages many teachers from prolonged use. The second is that the Technology Director's position within the organization bridges previously loosely coupled departments and creates new pathways for communication and collaboration. Finally, the findings suggest that technology trailblazers in the school can influence their peers' technology use more effectively than formal trainings, especially with the Technology Director's help. This study contributes to the current understanding of education reform and pedagogical change by integrating existing theories and observing how they manifest in the real world.

INTRODUCTION

In the words of Larry Rosen (2010), "We are literally in the midst of an educational technology revolution that is changing the definition and role of teacher. And many teachers are not happy about it" (p. 185). Technological change is progressing at an ever-increasing rate; whereas the radio took about forty years to permeate mainstream society, YouTube became a staple of modern culture after only a year (Rosen, 2010). Gone are the days of textbooks and overhead projectors; new technologies such as YouTube, Wikipedia, and Google have revolutionized the way that today's students encounter information, which concerns many teachers and parents. Although new educational technologies have sparked excitement in teachers and students, the education system has been slow in successfully adopting these potentially useful tools (Schneckenberg, 2009).

Policymakers assume that once a school garners the resources to invest in the acquisition of educational technologies, teachers will automatically begin incorporating these technologies into their everyday teaching practices. Historically, education reform follows a basic pattern: recognize a problem, construct a proposal to address that problem, and then put the plan into action. However, Cuban, Kirkpatrick, and Peck (2001) summarize that "the history of school reform aimed at substantially altering teachers' routine classroom practices is replete with school boards and superintendents adopting ambitious designs that often ended in little classroom change" (p. 815). In fact, "access to equipment and software *seldom* [leads] to widespread teacher and student use" (Cuban et al., p. 813). This is not only financially wasteful, but also prevents students from reaping the benefits of technologies.

This paper attempts to unravel and understand the organizational factors that affect the implementation of educational technologies. I analyze the barriers to change as well as the

success stories by closely examining the particular case of a suburban high school in the Midwest. I conducted interviews with teachers and technology staff at this school in an effort to understand the dynamics of technology and education at this particular school.

My initial research question was, "Why are schools so slow to adapt to changing technologies?" However, as my research progressed, I developed three more nuanced questions:

a) How does the quality of the educational technology itself affect teachers' usage decisions?
b) Does the Technology Director's position within an organization mitigate the effects of loose coupling?
c) Why is it that some teachers are able to use technology in interesting and creative ways, while others insist that they lack the time?

I begin with a review of the existing research related to this topic, focusing specifically on bureaucratic organizational structure and top-down implementation processes, as well as loose coupling and the diffusion of innovations. Next, I summarize the findings from a combination of qualitative and quantitative analysis of the interview transcriptions. In my discussion section, I present my major conclusions. The first is that educational technologies in this school were often unreliable and difficult to learn, which discouraged many teachers from prolonged use. Next, I argue that the school's Technology Director acted as a bridge between previously loosely connected departments, thereby facilitating communication and improving the chances of successful implementation. Finally, I argue that technology trailblazer influenced their peers more effectively than formal trainings, especially with the Technology Director's help.

LITERATURE REVIEW

This review of existing literature on organizational change begins with an explanation of the bureaucratic structure of high schools as well as the context in which schools operate. Next is a summary of the implementation process and factors that affect program fidelity. Finally, I

explain that a combination of loose coupling and a collaborative organizational culture can encourage the diffusion of innovations.

Bureaucracy and Top-Down Change

High schools are bureaucratic in structure, which Weber (1947) claims increases efficiency and predictability within an organization. Bureaucracies are characterized by monocratic hierarchies, which clarify the status relations between individuals and allegedly reduce arguments by setting up a regulated system of appeals. Bureaucracies also intentionally inhibit individuality, which Weber (1947) considers a source of uncertainty, waste, and corruption. Change in purely bureaucratic organizations develops at the top of the hierarchy and is subsequently imposed downward. Hoyle (1986) eloquently describes the process of change in a perfect bureaucracy:

> In a truly bureaucratic organisation, goals would be determined by those legally empowered to do so; the means to the achievement of these goals would be specified and codified; they would be passed down a hierarchy of technically competent personnel who would ensure the impersonal application of the rules. Thus the ideal type bureaucracy is, in theory, foolproof. If everyone went by the book then nothing could go wrong (p. 89).

Clear rules and hierarchies within high schools are intended to ensure that every student will graduate with the same set of knowledge and skills. A teacher is hired to a specific department, told which classes he or she will teach, and given a curriculum of topics and concepts to include. Set curriculums and rigid rules for teachers are thought to reduce inefficiencies and ensure that every student will leave with a solid educational foundation.

However, due to the unique and manifold set of expectations and demands that high schools face, they are resistant to widespread change. Not only are the administrators responsible to the students, but they also face pressures from the government, parents, and taxpayers. Means, Penuel, and Padilla (2001) explain that the “strictures and stakes associated with earning a diploma and gaining acceptance into college, the departmental structure, and the sheer size of

their staffs and student bodies all make high schools resistant to change" (p. XI). Due to this demanding set of obligations, high schools often have little autonomy in defining their own goals. Instead, goals are determined by the top of the hierarchy and subsequently imposed on individual schools and teachers (Chubb & Moe, 1990).

While bureaucratic structure is beneficial to the education system in that it creates stability and efficiency, when combined with political control it can constrain high schools in many ways and create barriers to the implementation of educational technologies. Administrators and top-level employees within the education system are motivated by the desire to uphold a public appearance, which increases the stakes of making changes because any mistake can be detrimental to a school's reputation and, in turn, its funding. The political interests that are inextricably interwoven with public high schools add one more layer of resistance to change because administrators are adamant about obtaining as much information as possible about a decision in order to reduce uncertainty (Wilson, 1989). According to Chubb and Moe (1990), "institutions of democratic control are inherently destructive of school autonomy...this happens because of the way all the major participants—politicians, interest groups, bureaucrats—are motivated and empowered by their institutional setting to play the game of structural politics" (p. 47). Innovations, therefore, are contingent upon executive interests and values.

Implementation and Program Fidelity

Even after administrators reach a decision, changes initiated at the top of the hierarchy are not automatically accepted; they first must go through the process of implementation. In the 1970s, researchers studying education reform began to examine the process of implementation, recognizing the chasm between a plan for change and the way that plan materializes (Olson, 1999). The RAND researchers define implementation as, "the stage where the project, as a

reality, first confronts another reality—the institutional setting of the school and the district" (as cited in Supovitz & Weinbaum, 2008, p. 6).

While the individual or institution planning the endeavor may resist efforts to co-opt the original design, adaptation is not necessarily a negative process. Even the best-laid plans for integrating educational technologies are typically adapted to fit in with the unique culture and organizational context of a particular school. In fact, Berman and McLaughlin assert that a project that is not adapted "probably never really 'met' the system. If nothing happens to change the setting, then there probably was no real implementation" (as cited in Supovitz & Weinbaum, 2008, p. 8). In other words, adaptation should be viewed as a necessary step of the implementation process rather than a sign of the plan's failure or inadequacy.

One way to anticipate adaptation and improve the chances of successful implementation is to involve teachers in the planning process. Cuban, Kirkpatrick, and Peck (2001) explain:

> Few…[failed] reforms noted the workplaces within which teachers labored, involved teachers in the design itself, allocated sufficient resources to develop teachers' capacity to implement the desired changes, or provided sustained support to ensure that those changes become part of the teachers' daily routines (p. 816).

It is essential that teachers feel ownership of efforts to integrate technology into the classroom in order to ensure long-term commitment to its success (Olson, 1999). Ruiz-Primo (2006) uses the term "fidelity" to describe the degree to which faculty members adhere to a new program. If teachers feel that a plan is being forced upon them without their input, fidelity will be low. The time frame in which a change takes place also affects fidelity; longer time frames typically correlate to greater degrees of adaptation and also prevent teachers and administrators from feeling rushed (Ruiz-Primo, 2006). Allowing teachers and faculty at a school to be part of the decision-making and planning process can be an effective way to ease the transition and improve program fidelity.

Another way to improve program fidelity, in the case of integrating educational technologies, is to create an adequate technology infrastructure to support teachers in their everyday use. Many teachers simply have not received enough training with educational technologies, and they lack the confidence and comfort necessary to be willing to integrate technology into the classroom (Bothma & Cant, 2011). Perkmen and Pamuk (2010) found that a teacher's belief in his or her own ability to successfully use instructional technology is an accurate predictor of future technology integration performance.

However, even when teachers' needs are taken into consideration and they are provided with adequate training, they may be reluctant to change their existing pedagogies. This is not to say that teachers are lazy or unimaginative; most teachers do, in fact, acknowledge technology's potential to improve student learning. The problem is that they often fail to translate these values into substantive pedagogical changes (Bothma & Cant, 2011). This can partially be explained by the fact that teachers lack the extra time necessary for learning something new (Cuban et al., 2001). In addition, teachers are given mandated curricula and must prepare students for standardized tests. These demands raise the stakes of experimentation and prevent teachers from trying new things. Resistance to change may also be due to teachers' existing ideas about teaching practice. Supovitz and Weinbaum (2008) argue that "individuals are heavily influenced by their existing cognitive structures, including their prior knowledge, beliefs and values, which together cause them to reshape and sometime misinterpret reform ideas" (p. 8).

As a result of numerous responsibilities and constraints, when teachers do use new technologies, they often use them in conventional rather than revolutionary ways. Cuban, Kirkpatrick, and Peck (2001) found that teachers in a high school in California used computers for little more than word processing. They argue that, "when teachers adopt technological

innovations, these changes maintain rather than alter existing classroom practices" (Cuban et al., 2001, p. 815). A major incentive to change is compatibility with current practice so that changes are viewed as improvements rather than innovations. Wilson (1989) explains, "educational changes have endured when they have not altered the core tasks of the classroom teacher and have faltered or disappeared when they have required a major change in those core tasks" (Wilson, 1989, p. 224).

However, high levels of adaptability can potentially compromise the technology's intended purpose and mitigate its potential to improve student learning. For example, in the 1820s educators were enthusiastic about new publishing technologies that allowed books to be printed and distributed for a fraction of the previous cost. Books are a flexible medium; they allow students to read at their own pace, flip back and forth, and continue to learn from home. Although this may not seem novel today, the introduction of books into the education system was once a potentially revolutionary change. However, schools failed to capitalize on the flexibility of books because, while some teachers used books creatively, many continued to use books to preserve the "lecture-recitation-seatwork" model of classroom instruction (Cohen, 1990, p. 233).

This is the unique conundrum of technological change in the education system; if a technology is not easily adaptable to individual teachers' needs, program fidelity will be low. However, if technologies are too adaptable, teachers may use them to preserve their pedagogies, in which case technology becomes a burden rather than an improvement. Designers of educational technologies, therefore, must keep teachers needs in mind during the design process.

Loose Coupling and Peer Diffusion

In addition to teachers' tendency to maintain existing practices, loose coupling also contributes to the disconnect between plans and actions in high schools. Even when the school takes great measures to ease the transition, the loosely coupled structure of high schools can inhibit the successful implementation of comprehensive, top-down change. Loosely coupled systems are composed of many subunits[1] with disparate goals, resources, and knowledge bases (Weick, 1976). High schools are particularly prone to loose coupling because they are "based on a half-dozen or more distinct bundles of knowledge that have their own internal logics and an inherent bent toward autonomy" (Clark et al., 1983, p. 16). Because these subunits are only loosely connected, decisions and initiatives produced at the level of the administration do not always translate into observable changes in day-to-day behaviors (Weick, 1976).

Some theorists focus on ways to combat the problem of loose coupling, calling for stronger leadership as a potential solution. Murphy and Hallinger (1984) argue that a strong leader can moderate fragmentation by creating tight cultural couplings, or emphasizing and clearly articulating unifying goals and missions. In other words, creating shared values can facilitate experimentation and innovation. In order to disseminate these unifying values, administrators and leaders within the school must spend time outside of their offices and make an effort to communicate with teachers and staff. In short, "managers can change the behavior of subordinates in loosely coupled systems if they build on subordinates' ongoing behavior, focus only on controllable and essential behaviors, and provide the freedom for subordinates to adapt the behavior to local needs" (Orton & Weick, 1990, p. 212).

[1] In high schools the subunits could either be individual teachers and faculty, classrooms, departments, or the school itself versus the district and state or national legislature (Weick, 1976)

Withane (1984) contends that loose coupling is not entirely negative because it creates havens of innovation in which teachers have the freedom to experiment in individual classrooms. Meyerson and Martin (1987) describe a paradigm of organizational change called "differentiation," which interprets organizations as a collection of semi-independent (or loosely coupled) subcultures rather than one monocratic system. Under this paradigm, changes are understood to be local and gradual rather than comprehensive and revolutionary. Loose coupling facilitates this type of small-scale transformation, creating opportunities for "deviance and change" (Meyerson & Martin, 1987, p. 636).

Loose coupling provides intellectual shelter to subunits because, "subunits can experiment and respond to turbulent environments knowing the effects of actions and interpretations will be localized and the organization, as a whole, will be buffered from the repercussions of their actions" (Meyerson & Martin, 1987, p. 635). Mandated curricula and the need to prepare students for standardized tests are intended to create more accountability, but teachers still have a degree of autonomy in their classrooms. Whereas administrators are responsible to the taxpayers, parents, and policymakers, loose coupling shelters teachers from these burdens and allows them to experiment. Loose coupling is positive in that "environmental complexity and uncertainty is…experienced as manageable" (Meyerson & Martin, 1987, p. 633).

Loose coupling creates an even greater level of freedom in classes that are on the "fringes" of the high school, or in non-mainstream environments such as Advanced Placement (AP) and Special Education classes. Teachers of these types of classes have more freedom to experiment because the curriculum is not as controlled as that of mainstream classes. Returning to the earlier example of books as a new educational technology, while most classrooms failed to use books in creative ways, there was much more variability and experimentation in AP classes.

Cohen (1990) explained that, because AP classes are not mainstream, they are able to bend the rules a bit.

Innovations are more likely to emerge on the fringes of the school, but a collaborative organizational culture can foster the creative spirit necessary for these innovations to spread (Supovitz & Weinbaum, 2008). According to Wilson (1989), organizational culture is a "distinct way of viewing and reacting to the bureaucratic world" and shapes individuals' actions within the organization (p. 26). Even in the absence of sufficient technology infrastructure and support, a school with a collaborative culture can effectively integrate technology because teachers will be willing to encourage, educate, and support each other in its use (Means et al., 2001). Cohen (1990) agrees that, "teaching is taught and learned as part of a popular culture over which professional agencies and official policies have little influence" (p. 200).

In fact, Schneckenberg (2009) suggests that peer influence may produce greater results than expensive and time-consuming traditional IT training. One of the reasons training does not often produce substantive results is that teachers' behaviors are influenced by the behavior of their peers. Teachers will be much more likely to change if they see their co-workers adopting new behaviors (Georgina & Hosford, 2009). Therefore, training is most effective when it involves an aspect of peer-to-peer education, thereby "manifesting in shared ideas and practices among faculty" (Georgina & Hosford, 2009, p. 691). In the words of Supovitz and Weinbaum (2008), "when norms of practice are in flux, or are the target of change by an outside force, the relationships between individuals in an organization can be a highly effective mode for transmitting new information" (p. 8).

A technology trailblazer, or an individual that is personally invested in technology use, can facilitate the creation of a supportive culture for technology use. Means, Penuel, and Padilla

(2001) contend that, "A technology champion…in the form of a principal of teacher-leader dedicated to technology or a strong technology coordinator, is critical in helping gain technology access for students and in helping to set a vision for technology use in the school" (p. 169). The most successful technology initiatives in public elementary and high schools have been those that are led by a passionate believer in technology's benefits (Means et al., 2001).

According to Cohen (1990), "successful invention, diffusion, and adoption are only the first steps for any innovation. They make a novelty available for use, but they guarantee nothing about how it will be used" (p. 236). Top-down change in high schools is often unsuccessful because loose coupling prevents communication and the diffusion of information. However, teachers of classes on the "fringes" of the education system have more flexibility to innovate, and a collaborative organizational culture can allow these innovations to spread through peer diffusion.

METHODS

I conducted a case study in order develop a deeper understanding of organizational theories regarding technology implementation in the education system. I interviewed nine staff members at a suburban high school in the Midwest. The interviewees included three teachers, five technology support staff, and the school's technology director. The purpose of the study is to identify organizational factors that either aid or impede the successful integration of technologies in the education system. I wanted to understand the needs and challenges of technology implementation from the teachers' perspectives, but also to understand the role that the technology support staff plays in facilitating technology implementation in this particular high school.

I chose to do a case study because my objective was not to obtain generalizable findings, but rather to apply organizational and educational theories to a case in order to understand how the theories materialize. Additionally, a single cross-sectional study was the most feasible research strategy given my limited time and resources. However, the case study approach also allowed me to gain an insider's perspective, as well as a holistic and nuanced understanding of the relationship between education and technology at this particular high school (Aaltio & Heilmann, 2009). According to Aaltio and Heilmann (2009), "case study methodology can be a rich source for understanding the multiple structures that support and sustain organizational life and business units." Timmons and Cairns (2009) explain that case studies are particularly instrumental to education research because they allow the researcher to analyze existing policies in practice and suggest improvements to policymakers and administrators. In addition, the flexibility of the approach allowed me to examine issues and trends that I had not anticipated in my original research questions. The study complicated and illuminated many of the theories included in my literature review on organizational implementation and educational technologies.

The teachers and technology staff I interviewed are based on a convenience sample; I contacted a wide variety of staff members at the school in order to obtain a diverse sample group that would represent many different roles within the school. I then interviewed those staff members that were willing to participate in the study. Although the sample size was small, consisting of nine interviews, I was able to speak to teachers in two different departments, technology support staff, and the school's technology director. My sample cannot be considered representative and my results cannot be generalized to other high schools, however, it is still broad enough to offer unique insight into the varying relationships with technology that exist within this particular high school.

In order to protect the identities of both the school and the teachers, I will not use the name of the high school, and each participant will be given a descriptive title (See Table 1). However, it is important to note some basic information about the high school in order to understands the context in which the study takes place. The school is situated in an upper-middle class and mostly white suburb in the Midwest. According to the CCD Public School Data for 2009-2010 (CITE), it has just under 3,000 students in grades 9-12. According to the Technology Director, there are over 1300 computers in the school, and subsequently the ratio of students to computers is about 2.3 to 1. The student population is 73% Caucasian, 15% Asian and Pacific Islander, 7% Hispanic, and 3% African American. 9.6% of students qualify for either free or reduced-price lunches. The town is classified as a large suburb, with a median household income in 2010 of about $75,000.

Below, I briefly describe each interviewee in order to provide additional context about h participant's background and responsibilities at the school:

Table 1: Description of Interviewees

Title	Age	Gender	Role/Responsibilities	Notes
Technology Director	50s	Male	Oversees technology budget, leads team of seven support staff, organizes trainings for new technologies	Taught chemistry at the high school for 24 years before becoming the Technology Director
Web Master	30s	Male	Updates and maintains the website, supports teachers and students with technology use	
Tech #1	Early 20s	Male	Troubleshoots general technology problems with students and teachers	
Tech #2	50s-60s	Female	Oversees drop-in lab and portable laptop carts	

Repair Tech	50s	Male	Fixes technologies in the classroom when they break	Has worked at the school for over ten years
Software Specialist	30s	Male	Installs, updates, and patches software throughout the school	A network specialist by degree
Teacher #1	50s	Male	Teaches upper-level calculus in the Math department	
Teacher #2	Late 20s	Male	Teaches science in the Special Education department	Voluntarily acts as a technology liaison for his department
Teacher #3	20s	Male	Teaches high-level students in the math department (college-level classes)	Teacher #1 considers him to be a technology pioneer at the school

I created two different sets of interview questions: one for teachers, and one for the technology staff (See Appendix for the full list of questions); the mean interview length was 24 minutes, and the average word count of the transcribed interviews was 3913 words. I then transcribed the interviews and analyzed them with a combination of qualitative analysis and inductive coding.

I began the coding process by looking over the notes that I took immediately after each day of interviews. The notes consist of my general impressions from the day's interviews. These summaries served as an initial guide for what to pay attention to when coding the interviews. For example, in the reflections, I wrote "Another theme that came up was the difference in interests and goals between the administration and district and the actual teachers and IT staff. The administration is concerned with public image and keeping the community, parents, and taxpayers happy with where the money is going. Teachers, on the other hand, are primarily concerned with students' learning. The IT Staff seems to be somewhere in the middle." From

these observations I created the codes “Different goals” and “Financial considerations” in order to capture this theme.

Initially I had a list of about ten codes based on the written reflections before even looking at the transcriptions. Next, I went through every transcript and created additional codes for themes and phrases that seemed salient or interesting based on the previous research I had completed. In an effort to avoid letting my expectations bias my findings, I also coded for themes that I had not anticipated. This process of making sense of the raw data is called “open coding,” which “builds from the ground up, by identifying essential concepts and patterns that emerge in vivo from an initial, yet rigorous open reading and reflection upon raw data” (Price & Cameron, 2009). After this first round of coding, I had created 44 codes, using every uninterrupted segment of speech, or “turn,” as my unit of analysis. The last step was to go back through all the transcriptions one more time, using the complete list of codes for all transcriptions. One weakness of my analysis is that, in an effort to protect the confidentiality of the participants, I did not have a second coder. Although I strived to maintain inter-coder reliability throughout my analysis, it is possible that a different coder could have attained different results, especially in regards to the more conceptual codes such as “Enthusiasm” and “Frustration” (Franzosi, 2003).

I narrowed this list down to twelve codes that I found particularly salient through a process called “selective coding,” which entails reflecting on major themes and relationships in order to narrow the data and develop a narrative (Price, 2009). Some of the codes were included because of their high frequency, while others were included because they illuminated relevant theories or challenges. Below, I list each major code and a brief description of its characteristics, along with the frequency of each code.

Table 2: Description of Major Codes
Total Number of Code Tags: 596

Code	Description	Frequency
Enthusiasm	Expression of excitement, optimism, or enthusiasm	46
Help is available	In reference to technology support, indicating a feeling of readiness of response from the technology department	44
Financial Considerations	Mention of the budget constraints involved in investing in new technologies	40
Lack of Communication	Between individuals, departments, the administration and the teachers, etc.	38
Work Load	Acknowledgment of the extreme work load and pressure that the technology staff is under	37
Frustration	Allusion to frustration or dissatisfaction with the school's relationship to technology	33
Hierarchy top-down	Reference to change coming from the administration and being imposed upon the school, or inability to change because of needing administration approval	23
Peer diffusion	Spreading of ideas among the staff	22
Different goals	Varying objectives of the administration, the teachers, and the technology staff	16
Hierarchy bottom-up	Change that originates from the level of the school and progresses up the hierarchy	11
Lack of time for learning something new	Teachers lacking time/energy to invest in learning to use new educational technologies	7
School vs. Business	The differences between the way that a school operates and the way that a business would operate	6

In addition to quantitative analysis in the form of coding, I also used a combination of inductive and deductive qualitative analysis to make sense of the situation at this high school. Evers and Van Staa (2009) emphasize that it is best to utilize "a combination of *structure* (built by theoretical notions and frameworks constructed in a deductive way) with *flexibility* (exploring the data with an open mind, i.e., induction)." The process was cyclical, as is most qualitative analysis (Evers & Van Staa, 2009). I will organize the findings section thematically, blending

code frequency analysis with notable quotations from the interview transcriptions in order to describe the story that I heard at this school.

FINDINGS

This section is organized thematically, using the major codes as a guiding structure. Below, I outline the major findings and provide a brief description of each section.

- **Enthusiasm and a Supportive Environment**
  - Two narratives emerged regarding technology's potential for student learning: technology's ability to appeal to various learning styles, and its facilitation of rapid access to new information.
  - The school's ample technology budget gave teachers access to a wide variety of educational technologies.
  - Teachers felt generally supported by the technology staff.
- **Teachers' Concerns and Needs**
  - Teachers lacked the time to dedicate to attending trainings and learning to use educational technologies.
  - Teachers were especially unlikely to use technologies that were unreliable or difficult to learn.
  - Teachers were frustrated with the school district's slow decision-making processes.
- **Frustration Among Technology Staff**
  - The technology department had trouble keeping up with the workload.
  - They were also frustrated by miscommunication between the district, the administration, and the technology department.
- **Potential for Change**
  - Technology trailblazers were personally interested in integrating technologies.
  - Technology trailblazers also facilitated peer diffusion.
- **Technology Director Aided Communication**
  - The Technology Director's position in the organization allowed him to understand varying needs of different departments.
  - The Technology Director was sensitive to teachers' needs and offered high levels of support.
- **The Help Desk: An Illustrative Example**
  - This example illustrates the ways in which the above conclusions interacted in this high school.

Enthusiasm and a Supportive Environment

Although this school certainly had its share of problems and frustrations with technology implementation, which I will describe below, the administration, technology staff, and teachers

all recognized the value of integrating technologies into the learning environment, which is an important first step in the implementation process. The teachers and technical support staff showed a relatively positive attitude towards the school's relationship with technology. Statements related to enthusiasm appeared 46 times in my data, which is more frequent than any other in my coding scheme (see Table 2).

Technology's Potential for Student Learning

More specifically, every respondent acknowledged technology's potential to enhance student learning. One of the first questions that I asked every interviewee was, "In what ways do you think that technology could enhance a student's education?" Two major themes emerged and eight out of the nine respondents fell into only one of these two categories. The first was that technology appealed to many learning styles by presenting information using a variety of media. The second was that technology enabled the rapid dissemination of new information. I will describe which respondents fell into each category of response, but it is first worth noting that there did not seem to be any major difference between the responses of the teachers and the technology staff.

Of the nine respondents, two teachers (Teacher #2 and Teacher # 3) and three members of the technology staff (Web Master, Tech #1, and Tech #2) mentioned that videos, PowerPoint, and audio clips engaged students by appealing to different learning styles. Teacher #2 explained that technology "hits more modalities" (line 4) and that, as a result, "technology is really more engaging" (line 9). Teacher #3 agreed that high school students often had trouble visualizing complex three-dimensional shapes, and teachers' drawing abilities were insufficient. However, tools such as PowerPoint allowed students to see an accurate visual representation. The Web

Master remarked, "[it provides] a richer learning experience…Technology is really more the vehicle for getting them to think in different ways…" (lines 29-30, line 38).

This perspective was characterized by the belief that technology was primarily a supplementary tool for education as opposed to one that radically altered teachers' pedagogies. Teacher #3 summarized his view with the following quote: "We're using technology to supplement their experience rather than drive the experience and I'm okay with that for now cuz that's where we are technologically" (lines 10-12). This ideology interpreted technology not as a revolutionary force, but rather as a tool to enhance existing practices.

The other emergent view of technology's contribution to student learning was that it allowed for the rapid dissemination of new information. This viewpoint was slightly less frequent, with only one teacher (Teacher #1) and two technology employees (Repair Tech and Software Specialist) falling into this category. Teacher #1 stated that students "learn so much faster via technology than old-school textbooks and note and paper" (line 14). The Repair Tech explained information sharing in terms of his own learning; "I'll do something for ten years and…I'll Google it and…some other teacher out there in the UK looks at it a different way and…it's a new way of looking at it" (lines 33-35). The Software Specialist said that some classrooms used video conferencing with schools in other parts of the country and in other parts of the world, which allowed students to collaborate and expanded their opportunities for learning. As opposed to the first outlook, which interpreted technology as a supplement to education, this viewpoint valued technology's ability to expand the database of knowledge from which students and teachers can absorb information. Respondents in this category understood technology as tool that enabled collaborative and dynamic learning.

Budget is not a Barrier

Enthusiasm was important to this case study because it demonstrated the school's commitment to educational technologies, which is a necessary prerequisite to successful implementation. This commitment to the attainment of educational technologies manifested in the form of the technology department's large budget allocation. In the Web Master's words, "we seem to have a fairly decent budget for technology so [the administration is] clearly recognizing that it's important…and because we have the funding, we're able to implement…programs" (lines 187-189). Part of this was, of course, due to the fact that the school was in a stable financial position. However, there were many other ways that those in charge of the school's budget could have allocated this money, and they chose to designate a large portion to technology. When asked what made this high school different from others in terms of its relationship to technology, Tech #2 replied, "they're willing to spend the money" (line 124).

The budget, in turn, boosted enthusiasm by providing teachers with a high level of access to educational technologies. The technology staff concurred that teachers had access to just about every educational technology that they needed. According to the Technology Director, "there's quite a wealth of technology available to the teachers" (line 129). The Repair Tech agreed that, "If they squawk loud enough they seem to get it…and they do squawk, you know" (lines 70-71). The teachers also reported having just about everything that they needed. Teacher #3 cleverly explained that, "It's like a technology buffet, it's all there and it's just how much you choose to use" (lines 113-114). When I asked Teacher #3 if there were any technologies that he wanted to use but didn't have access to, he simply responded, "there's technologies I want that don't exist yet," but "there's not many things that…I need that I don't have" (line 252, lines 312-313). The

teachers and technology staff both appeared satisfied with the amount of technology available at the school. A description of the types of technology provided for use by teachers is presented in Table 3 below. While this list is not comprehensive and does not include software, it is as thorough as possible based on the information that I gathered throughout my interviews.

Table 3: Technologies Available to Teachers

Available in Every Classroom	• Document camera • Ceiling-mounted projector • Desktop computer (with capability to connect to personal devices) • DVD/VCR player
Available to be checked out	• Electronic White Boards • Laptop carts • Classroom Response System
Given to teachers	• Laptops

Availability of Technology Support

In addition to being pleased with the amount of technologies available, teachers and technology staff also reported feeling satisfied with the level of technology support in the school. This is a significant predictor of teacher usage, because teachers need to know that they will receive immediate assistance if something were to break during a lesson. This claim is supported by the fact that "Help is available" was the second most frequent code, appearing 44 times throughout my coding scheme. According to the Repair Tech, "most of [the teachers] are thrilled…they filled out surveys…[and] we got…some of the highest marks at the response time and the friendliness" (lines 184-186). The Tech Director proudly told me that "we are…I don't want to say spoiled, but we certainly are above the norm as far as technology support…we have it really really good…and teachers have come to expect the support" (lines 183-184).

Teachers' Concerns and Needs

Although enthusiasm at this school was overwhelming, it was not universal. Frustration was also a frequent code, appearing 33 times throughout the interviews (See Table 2). Despite the positive attitude and availability of technology support, teachers became frustrated with technologies that were time-consuming and did not fit in with their existing classroom practices. Teachers' qualms about technology integration were fueled by both a lack of time and a general dissatisfaction with the technologies' quality and ease of use.

Lack of Time

Despite the "technology buffet" and abundance of technology support, the Technology Director reported that some teachers failed to take advantage of available technologies due to a limited amount of free time. The code "lack of time for learning something new" only appeared seven times throughout the interviews. However, two of the three teachers that I interviewed were avid technology users, which may have contributed to the infrequency. Teachers' lack of time is still an important theme, however, because it discourages teachers from attending training sessions and is also a barrier standing between teachers and long-term technology use. The Technology Director explained:

> Sometimes we say teachers are…the worst students because, you know, they will challenge kids all the time, but if they have to sit down on their own time to learn something, they oftentimes don't wanna do that. They just want the quick answer, and I understand that fully as a teacher because we're so busy (lines 276-279).

Teacher #1 confirmed that his lack of time prevented him from learning how to use technology. He conceded, "I've always thought about setting up a blog, um…I'm sure it's not that complicated to do…I just haven't had the time to sit down…and get it started" (lines 127-129). The Technology Director also recalled feeling rushed and overwhelmed when he was a teacher; "If you can just give me the nuts and bolts of what I need, then I'm a happy camper...I'll

sit down, you know, given the time and learn something on my own, but [not] when I've got three different things going on in my classroom" (lines 281-284). Time constraints discouraged teachers from attending technology trainings because they were not mandatory and there were few formal incentives for attending. Teacher #3 explained, "I can learn it faster just by clicking around myself… trainings…are valuable for some people and I'm guessing there will be a point in my life where I will not be up-to-speed on technology and I'll need those trainings, but right now it just slows me down and wastes my time" (lines 120-123).

Technologies Are Unreliable and Time-Consuming

The teachers' main priority when deciding whether or not to use an educational technology was that it worked, and that their lesson plan would not be compromised because of technical difficulties. However, teachers reported frequent technical difficulties and malfunctions, which generated a great deal of frustration as well as reluctance to continue to use failing technologies. Two out of the three teachers (Teacher #2 and Teacher #3) were disappointed with the quality of the educational technologies at this school. Teacher #3 explained that, if a technology were to break during class, some teachers, "wouldn't know what to do because they're…not very comfortable with…being in a computer lab with a weird piece of software…so, you know, it makes them just hesitant to use technology at all" (lines 384-387). When asked about the school's general attitude towards technology, the Web Master replied "I would say it's hugely positive...I mean…provided that [technology] works" (line 178). The Software Specialist added that, "if there's a glitch [teachers] really get upset" (lines 137-138). Technology's unreliability eroded teachers' confidence and may have prevented prolonged integration.

Teacher #3 speculated that educational technologies, in comparison with technologies produced for other industries, were often of a lower quality because "the people who make technology for…schools…there's certainly money in that but it's not the same sort of money that you're gonna have…developing…consumer electronics" (lines 194-198). He illustrated the inadequacy of educational technologies with the example of the graphing calculator, calling it a "sin" that it remained so expensive and yet had not advanced much in the last fifteen years (line 199). Teacher #2 used the example of the Classroom Response systems, which allowed students to respond to questions with clickers so that teachers could immediately gauge their understanding. He described the technology as "awkward," "difficult to use," and time-consuming (Teacher #2, line 62). Teacher #2 also reported that the programming performed by the technology staff in-house was of low quality. The technology staff created the current IEP system at the school, and Teacher #2 was on a committee to purchase a new IEP system. He explained his surprise when he realized how superior commercial products were; "seeing what these companies make…compared to what we can make in-house has really <laughs> been a revelation" (lines 339-341).

Bottom-Up Change is Slow

Another source of frustration for the teachers at this school was that bottom-up change was a slow and arduous process, which often deterred teachers from trying to gain access to any new technologies. In my coding scheme, I labeled this "Hierarchy bottom-up," which appeared 11 times throughout my coding scheme. Although it was less relevant and visible to teachers than "Hierarchy top-down," which appeared 23 times, it is still an interesting theme to explore.

The Technology Director described the process of relaying teacher requests for new technologies to his superiors. First, he consulted with the teacher's department chair to discuss

the possible educational uses of the device. If the device passed this first test of agility, it proceeded to the director of educational technology for the district. Next, they once again discussed the pros and cons and at that point might have decided to buy a few devices for a trial period. This process was time-consuming and, as a result, even the Technology Director admitted that the district was not at the cutting-edge of technology; "[the district] is not known for…being at the forefront of technology" (line 352). Teacher #3 explained that the district:

> …Is often reactive rather than proactive…we'll get the technology but we'll wait until everybody else has done it to see how it goes, which means…in the education world that means then you're fifteen years behind because every school's five or ten years behind so…we're even further back (lines 349-353).

Teacher #1 agreed that, "this district moves very very slowly…because it's gotta go through committees, it's gotta go through so many individuals and everybody has to agree upon it and then higher-ups have to say yes, I mean…it takes a long time for change in here and…it inhibits you from starting anything" (lines 196-200). He continued, "I think many teachers in this district believe, 'I can control what's in my classroom, outside of that, I can't control anything'" (lines 206-207). Teacher #1's comments suggested that at least some teachers felt that the bureaucratic structure at this school inhibited bottom-up change and prevented teachers from trying to gain access to new educational technologies.

Frustration Among Technology Staff

The unreliability of educational technologies also created frustration among the technology staff because constant breakdowns equated to an overwhelming amount of work. The technology staff also complained about the lack of communication between themselves, the district, and the administration.

Workload

Both teachers and technology staff agreed that the burden of responsibilities placed on the technology department was overwhelming. "Work Load" appeared 37 times throughout my coding scheme. Among the technology respondents, "Work Load" appeared 4.2 times per interview, on average. Furthermore, every respondent except for one (Tech #2) mentioned the workload at some point during the interview, including all three teachers. Teacher #1 recognized, "they are crushed, they just change so much so often." This suggests that the technology staff's complaints about having too much work was not just a result of laziness, it was a salient issue that the teachers also acknowledged.

The "Work Load" code appeared nine times in the Software Specialist's interview, which was more times than any other participant. Rather than attributing the workload to the insufficiency of the technology, however, he suggested that the district's inconsistent buying strategies were to blame. He explained that the major problem for his job was that the people in charge of purchasing the school's technology were most concerned with finding the best bargain, and therefore did not take the school's needs into consideration. The district's inconsistent purchasing approach created mayhem for the technology department:

> I have to support…15 or 16 desktops, 13 or 14 portables, different makes, models, types, we have netbooks, minis, and then tablets and laptops...this is frustrating our groups a lot, having to support so much random stuff and that means I have to make special images just for one lab because it's a different model that is not compatible with the hardware drivers for this model…it makes my life a living hell, literally (lines 213-214, lines 197-200).

In addition to placing stress on the technology staff, the Technology Director admitted that the workload distracted the technology staff from attending to long-term technology goals. It seemed that most of the technology staff's time was spent troubleshooting hardware issues rather

than supporting long-term and effective technology integration. The Technology Director explained:

> We have over 1300 computers in the school and that can be a very huge, daunting task sometimes, it's just absolutely amazing all the computers and all the issues that can creep up on a daily basis. I will have a list of things I want to accomplish in a given day, but that could all be thrown out the window at 7:30 in the morning if some issues arises that we have to deal with (lines 18-22).

Teacher #3 also noticed that the technology was distracted and, despite their best efforts, was not always able to fully support teachers. He summarized:

> The tech department…is being pulled in a lot of different directions because…things break a lot…there's so many little mini crises going on…[and] I think it would be hard to have a sustained support network for [technology innovation]…because…they might wanna help but then have a million other things with…all these things that constantly break…they might get distracted by that (lines 360-365).

While there was some discrepancy as to whether educational technologies in general are inadequate or if the district is just investing poorly, the quality of technologies at this school deterred prolonged teacher use. Teachers lost faith and patience with the constant breakdown of educational technologies, and these malfunctions also prevented the technology staff from supporting long-term technology initiatives.

Lack of Communication

The other source of stress for the technology department was the lack of communication between teachers, technology staff, district, and administrators. Frequent statements, 38 across my interviews, indicated that a lack of communication among school staff was a pertinent issue in this school. When asked, "What improvements could be made regarding the school and its support for technology use?" four out of the six technology staff members responded that communication was the biggest issue. The Repair Tech bluntly stated that, "something that

you're gonna hear more times than you ever care to hear is just keep the lines of communication open" (lines 221-222).

The technology staff at the school recently underwent structural changes that created confusion about job responsibilities. Although I did not get a complete account of the changes, according to the Software Specialist, "there's too many people and they don't know…who's in charge and what their job is [because] of all the title changes, they really don't…even know…what they're supposed to do" (lines 251-254). This restructuring caused a bit of a panic and a great sense of uncertainty about job security among the technology staff. The Software Specialists added, "they're…phasing out certain positions on purpose over there…[that's] what I think and what people have been generally talking about" (lines 254-256).

While a great deal of miscommunication was due to a recent restructuring of positions within the technology department, the varying goals of administrators and district employees as well as top-down bureaucratic decisions also contributed to the communication problems at this school. "Hierarchy top-down" appeared 23 times throughout my coding scheme and was mentioned by both technology staff and teachers. The Technology Director affirmed that the staff often received mixed messages as to what was most important:

> The staff I have is supposed to answer to me, but they actually have many bosses because we'll have an administrator come down, for example, and say, "I need you to do this in the web page right now," whereas…my webpage guy may be working on something else that I've got him doing…And so who gets the priority there? Sometimes they get caught in the middle because they're being hounded to get something done immediately whereas I have something else that I want them to get done immediately (lines 385-391).

This was stressful for the technology staff and was also detrimental to their productivity and efficiency. The Software Specialist explained a recent incident in which two members of the technology team received different information regarding a software update:

> It was two people sending two things to two groups separately, and they didn't coordinate the efforts at all, and that was his manager so I don't know if it was his fault or the manager or what, but either way it was really confusing (lines 269-271).

The poor communication between the district, administrators, and the technology department at this school was confusing to the technology staff and also detrimental to their productivity. The administrators had different priorities than the Technology Director, and the technology staff was often unsure as to whose priorities should take precedent.

Potential for Change

Both the teachers and the technology staff at this school demonstrated a combination of enthusiasm and frustration regarding the school's relationship with technology. I asked every technology staff member, "How would you describe the school's general attitude towards technology?" Although most (all except the Software Specialist) initially responded with enthusiasm, four (Technology Director, Web Master, Tech #1, and Software Specialist) also stipulated that enthusiasm was not universal. Despite these mixed feelings and frustrations, there were several examples of teachers who were able to overcome challenges and use technologies in interesting ways. For example, Teacher #3 was frustrated by the technical difficulties at this school such as malfunctions with the wireless Internet or inability to access his network drive. However, he did not see this as a reason to lose faith altogether. Instead, he responded that, "when those days happen, a day that you really need the technology you have to…adjust on the fly…I just view that as…an occupational hazard and…accept that risk and…run with it" (lines 382-383).

Technology Trailblazers

Teacher #3 was a prime example of what he himself termed a "technology trailblazer" (line 137). Technology trailblazers were personally interested in technology in their own lives,

and they brought that energy and passion with them into the classroom. The Technology Director described these types of teachers as "geeky jazzed" on technology (line 228). Both Teacher #2 and Teacher #3 described themselves as technology trailblazers.

For example, Teacher #3 taught a multi-variable calculus course for advanced math students. The class was unique because it was entirely computer-based; students spent their time writing code and working independently. This class required a significant time investment from Teacher #3; he spent a year going through training and learning how to facilitate online courses. He had to learn to act not as a teacher, but as a "facilitator," helping the students when they got stuck, but otherwise letting them figure it out for themselves. In this case, Teacher #3 was able to find the time to dedicate to completely changing his pedagogy. Teacher #2 also acted as a technology trailblazer through his role as the "tech coach" of his department (line 82). Each department had a technology leader, according to Teacher #2, who was viewed as the technology expert. Other teachers in the department could go to the technology leader for help with educational technologies. When asked why he had volunteered, teacher #2 replied, "I've always enjoyed using [technology]…I kinda jumped in when I started teaching" (line 83).

Peer Diffusion

These "trailblazers" facilitated peer diffusion by acting as leaders and introducing new ideas into the network of information sharing. They went out into the world, sought out new ideas for using educational technologies, and brought that information back to the school. In other words, "that's how it is with technology, you have a couple trailblazers that you…emulate what they're doing and you incorporate it in your own teaching" (Teacher #3, lines 137-8). The code "peer diffusion" emerged 22 times throughout my coding scheme, supporting the claim that

it was a salient storyline in this high school. Teacher #2 added that "it's kinda nice when we get newer teachers to see what they're doing…[and] collaborate or steal their ideas" (lines 86-87).

Although the Technology Director did organize technology trainings for the teachers, they were not often held at convenient times, and teachers often preferred to learn from each other. Teacher #3 explained, "A lot of the stuff that I learned was not from tech trainings but from other teachers" (lines 131-132). Teacher #1 affirmed that he learned primarily from other teachers in his Department. The Technology Director also noticed this trend; "people are starting to share with one another in departments, so that fever catches and spreads" (lines 232-233).

Technology Director Aided Communication

The Technology Director, rather than being disappointed that teachers did not take advantage of the trainings that he provided, was enthusiastic about the dynamic of peer diffusion in this school. He said, "I like that back and forth, and that way I don't have to be the end-all guru to all the technology in the building…I love it when teachers come to me and say, 'can I show you something?'" (lines 298-301). In fact, after noticing the effectiveness of peer diffusion, the Technology Director decided to try to emulate this system of information sharing among students by creating a student technology squad. He taught interested student trailblazers about new technologies with the goal of "get[ting] them to a point where they can actually train…other students" (line 65). Clearly, he recognized and appreciated the power of peer diffusion in this school rather than fighting unconventional forms of change.

The Technology Director took advantage of his unique position within the school, as well as his background as a teacher, in order to bridge the communication gaps between departments and facilitate the spread of information. He seemed always to be paying attention, and when he noticed an opportunity he intervened:

> One thing I've learned in this role is you can't force technology on people, you have to recognize the signs when a teacher is ready to do something with technology, and, when I see that I will go and tap…on their shoulder and say, 'I've got something you might be interested in…would you like to pursue this?'" (lines 225-228).

Bird's Eye View of the School

The Technology Director's position granted him a bird's eye view of the school. He was in constant communication with the teachers, the technology staff, the administrators, and the district employees. He understood the goals and pressures of each separate unit, and worked tirelessly as a liaison in order to find solutions and compromises. The code "Different Goals," which appeared 16 times throughout the coding scheme, embodies this idea. Teacher #1 explained, "Teachers are really student based, whereas the administrators have to account for…community perceptions" (lines 183-184). The Technology Director understood, for example, that administrators and district employees were highly concerned with budgets. For example, he spoke about "financial considerations" eight times during his interviews, which was more than any other respondent. The Technology Director used his position within the organization to the school's advantage, acting as a bridge between the different and somewhat isolated subunits within the school.

He also understood and listened to teachers' requests. He was constantly interacting with the technology trailblazers. He said, "I have some teachers in the building who are just, they went out and bought their own iPADs…they're starting to find ways to use them with the kids" (lines 231-232). The Web Master added that, "some new teachers come in and they're setting up their websites on the first day…exploring…what options we have here in our department…[and] how they might make best use of the computer labs" (lines 58-61) The Technology Director said, "every year…teachers will come to me and they'll say, 'you know, I saw this really great device at a conference, or I saw it online, or I heard some friends at another school talking about it, how

can we get one here?'" (lines 136-138). He worked to find solutions and compromises that would allow teachers to get what they wanted while staying within the boundaries of what was possible for the district.

Background as a Teacher

The Technology Director also suspected that his background as a teacher contributed to his ability to understand the needs of the administration, technology staff, and teachers. Someone from a strictly technology background may not, for example, have understood the urgency of a projector failing in a classroom. The Tech Director, however, would "hate to see lesson plans thrown out the window because some sort of technology that they're using is not working all of a sudden" (lines 410-411). He explained, "it helps having a teacher in this role because the teacher can relate to the teachers and understands their world and their life" (lines 447-448). The Repair Tech also mentioned that the Technology Director's background as a teacher helped him to better understand teachers' needs;

> Because he was a chemistry teacher, you could even say that he is still a teacher but he took a different role…he's very good about being available…and he is a good teacher…[he] has always been exceptional as far as being available for questions, I don't think he's ever turned anybody down" (lines 148-155).

The Help Desk: An Illustrative Example

I will end the findings section with an example that illustrates the ways in which the above themes and narrative intersected and interacted within this school. While I have separated the findings into sections for the sake of clarity, in reality all of these themes were simultaneously at work. The Help Desk example demonstrates the negative effects of loose coupling, the need for technologies to be user-friendly, teachers' tendency to adapt technology to their particular needs, the unique role of the technology director, and frustration among the technology staff regarding the excessive workload and miscommunication.

The Help Desk system was the preferred avenue through which teachers could request technology support. The school, in the last year or so, started using the program to keep track of work orders. The Help Desk appeared as an icon on teachers' desktops, and from there the teachers could fill out a slip to request technology assistance. The technology department electronically received a work order and attended to requests in the order in which they were received. Every request for technology assistance was supposed to be processed using the Help Desk, in an effort to improve organization and communication, as well as to keep a record of the amount of work that the technology department was doing.

There was some disagreement as to whether the teachers knew how to use the system and simply chose not to, or whether they really did not know how it worked. The Repair Tech argued, "there's no doubt about it, they know about the Help Desk and a lot of them refuse to use it," (lines 158-159) whereas Teacher #1 said, "Uh…I don't even know where Help Desk is <laughs> but once again I'm just old school, I'll go talk to somebody face-to-face" (lines 115-116). The confusion about the Help Desk was an example of loose coupling, demonstrating that information was not always uniformly distributed to various departments. While the technology staff seemed confident that all teachers knew how to use the Help Desk, loose coupling and miscommunication between different departments prevented the successful implementation of this technology.

Although some teachers did not know how to use the Help Desk, others intentionally chose to use other modes of communication. All three teachers used different methods of seeking assistance based on their individual preferences and needs. Whereas Teacher #1 preferred to talk to the technology staff face-to-face, Teacher #2 used the Help Desk, and Teacher #3 preferred to communicate with the Technology Director via email. Part of the reason that teachers were

hesitant to use the Help Desk as that it was slower than calling or visiting the technology support staff in person. Teacher #2 agreed that when a technology broke down in a classroom, it became an urgent situation; "I'd imagine [the technology staff] get[s]…their fair share of people running in panicked and saying this doesn't work" (lines 193-194). This demonstrates teachers' inclination to adapt technology to their needs, and shows that teachers did not unconditionally accept top-down organizational change. It also illustrates teachers' need for technologies to be user-friendly; the Help Desk was cumbersome and time-consuming, therefore many teachers found other avenues of communication.

The fact that the Technology Director was willing to accept requests and correspondence through outlets other than the Help Desk also demonstrates his role as a facilitator of communication. Rather than resenting teachers for refusing to use the established methods, he understood the inadequacy of the Help Desk and offered his support in other ways. Teacher #3 counted the number of times that he had emailed the Technology Director in the previous week, and it amounted to more than seven times. When I asked him if this was typical, he responded, "well I've got a good rapport with our tech director and…I'm often emailing him for things other than just…problems…if I email him he'll…look into it" (lines 242-244).

The Help Desk is also an excellent example of one of the technology staff's major frustrations: miscommunication between the district, the administration, and the technology department. There were rumors that the district was considering outsourcing technology support to a private company, and the Help Desk might have been a way for the district to keep track of the amount of work that the technology department did from day to day. Teacher #1 reported, "[the technology staff] are concerned that [the district is] gonna outsource their…jobs…so what they're saying [with the Help Desk] is, look how much we actually do on a day-to-day basis"

(lines 121-123). The Help Desk was an attempt to remedy the lack of communication between the administration and the technology department, but it was viewed as threatening rather than helpful. The Repair Tech explained that, "The people at the ad[ministration] building had no idea what you were doing all day whether you were playing solitaire on your computer or whether you were getting stuff done, so that disconnect I was referring to before" (Repair Tech, lines 173-175).

The Help Desk example illustrates the complexity of the dynamics of technology implementation in this high school. Next, I integrate the theories discussed in the literature review with the findings from my analysis, offering three major takeaways from this case study.

DISCUSSION

The literature review examined the organizational factors that affect efforts to integrate educational technologies into high school classrooms. A plan for integrating educational technology is only the first step of implementation; the technology also must be adapted to the individual school and the teachers' needs. However, loose coupling and bureaucratic structure impede communication and hinder efforts at top-down, organization-wide change. Loose coupling creates divisions between teachers, the technology staff, and administrators. These divisions discourage and prevent communication between different subunits, but at the same time loose coupling creates havens of innovation in individual classrooms. It protects teachers against the pressures faced by administrators and provides them with a degree of autonomy to experiment with educational technologies.

The findings section suggests that this high school's strong financial situation gave teachers access to a wide variety of technologies. Teachers agreed that they had access to just about every technology they could ever want or need. However, they reported frustration with

existing technology's poor quality and steep learning curve. The constant breakdown of technologies, combined with a lack of communication with the administrators, also created an unmanageable workload for the technology staff and prevented them from supporting more long-term technology endeavors. Despite these issues, "technology trailblazers" within the school set an example for their peers and spread innovations through a process known as peer diffusion. The Technology Director at the school also counteracted the effects of loose coupling because his unique bird's eye view of the organization as well as his background as a teacher allowed him to understand and coordinate the goals and needs of different departments within the school.

My original research question was, "Why are schools so slow to adapt to changing technologies?" I was interested in understanding how the organizational structure of high schools, as opposed to financial constraints, either aids or impedes the integration of educational technologies. Throughout my research, I developed three more specific research questions:

a) How does the quality of the educational technology itself affect teachers' usage decisions?
b) Does the Technology Director's position within the organization mitigate the effects of loose coupling?
c) Why is it that some teachers are able to use technology in interesting and creative ways, while others insist that they lack the time?

Below, I discuss each of these questions based on both theories described in my literature review and the results of my data analysis.

The Quality of Educational Technologies

One major theme from my findings section is that technology developers must take into account teachers' needs and priorities when designing educational technologies. Several teachers mentioned that existing educational technologies were time-consuming and difficult to use, which hindered program fidelity because of teachers' many obligations and responsibilities. Although avid technology users accepted the risk of technology breakdown and prepare backup

plans, teachers who were uncomfortable with technology were not as understanding. Teachers at this school expressed frustration regarding technology's unreliability and tendency to break, which diminished confidence and prevented continued usage. Cuban, Kirkpatrick, and Peck (2001) explain, "Professionals who depend on technologies on a daily basis require reliable machines and software. If technical glitches occur weekly or a few times a month, then confidence in the technology's worth erodes and contributes to sustaining current teaching practices" (p. 829).

The unreliability of technologies also created a burden for the technology department, preventing them from focusing on broader technology efforts because the majority of their time was dedicated to maintenance rather than long-term support. Implementation is a gradual process, and without continued support and encouragement, initial enthusiasm dwindles. The Software Specialist confirmed that enthusiasm was waning; "physically they're going forward, enthusiastically it seems to have slowed down a lot…teachers…seem to be losing interest" (lines 133-136). As discussed in the literature review, access to technology does not guarantee widespread use. The Technology Department would have had much more time to devote to supporting long-term technology use if they were not so busy dealing with hardware failures and glitches.

If technology developers work with teachers throughout the design process, they can better cater the technology to teachers' needs and thereby encourage prolonged use. Furthermore, districts need to exercise caution when purchasing technologies. The Software Specialist suggested that perhaps, rather than blaming technology companies for creating inadequate machines, the district's inconsistent buying practices may be to blame. Either way, successful implementation necessitates reliable and easy-to-use technologies.

The Role of the Technology Director

The lack of communication between the administrators and the technology department, as well as the incomplete implementation of the Help Desk system both demonstrated the existence of loose coupling within this school. As discussed in the literature review, loose coupling is essentially the detachment between different subunits in an organization, which leads to a lack of communication and thereby inhibits organization-wide change (Weick, 1976). Loose coupling can be an impediment to the implementation of educational technologies because it interrupts the spread of information among teachers, the technology staff, and the administration.

However, the Technology Director introduced a new dynamic to the organizational structure of the high school. His background as a former teacher at the high school as well as his communication with the administration, the technology department, and the teachers mitigated the effects of loose coupling. He understood the different goals of each subunit with the organization, and worked to remedy loose coupling by acting as a liaison between otherwise disconnected departments. Although top-down change was difficult to achieve in high schools due to their organizational structure, the Technology Director introduced a new organizational dynamic that encouraged peer diffusion by creating a collaborative culture and a supportive environment for technology experimentation. His role allowed him to identify "technology trailblazers" and encourage them to share information with their peers.

Technology Trailblazers: Exceptional Usage Among Select Teachers

I was interested in learning not only why many teachers fail to use technology in unconventional and creative ways, but also why some "technology trailblazers" are able to manage organizational barriers and use technology effectively. My findings suggest that these technology trailblazers were often teachers who were personally interested in technology and

therefore made an effort to integrate technology into the classroom. Technology technology trailblazers had more room to experiment on the fringes of the school, such as Advanced Placement and Special Education classes, but they also influenced their peers in mainstream classes by sharing this information. Furthermore, teachers reported preferring peer-to-peer diffusion of information to the formal trainings provided by the technology department. This suggests that high schools can improve implementation by recognizing the efforts of technology trailblazers and encouraging them to collaborate and communicate with their colleagues in order to facilitate peer diffusion of technology innovations.

The results of my analysis show that, while loose coupling and bureaucratic structure impeded technology implementation to some extent, the technology director and technology trailblazers were able to moderate these challenges in certain circumstances and use technologies in innovative and effective ways. These findings suggest that educational technologies are adding a new dynamic to high schools' organizational structure that may, in the future, facilitate the widespread diffusion of technologies in classrooms.

CONCLUSION

In order to understand the organizational factors affecting technology integration in high schools, I conducted a case study of a high school in the Midwest consisting of interviews with three teachers, five members of the technology staff, and the school's technology director. The review of the literature described that, although bureaucracy and loose coupling inhibit organization-wide change initiated at the top of the hierarchy, loose coupling also provides teachers with a degree of autonomy to experiment in individual classrooms. After a combination of quantitative and qualitative analysis of transcriptions from each interview, I reached three major conclusions. The first is that teachers will be much more likely to experiment with

technologies that are user-friendly and reliable. The second is that the Technology Director creates new channels of communication between previously loosely coupled departments, thereby mitigating the effects of loose coupling. Lastly, technology trailblazers influence the behavior of their peers and encourage technology usage more effectively than trainings provided by the technology staff.

My research generally confirms Cuban, Kirkpatrick, and Peck's (2001) findings from their case study of two high schools in California. They found that, in order for schools to successfully integrate educational technologies in a way that alters existing teaching practices, the following changes must first occur:

> Fundamental changes would need to be made in how schools are organized, how time is allocated, and how teachers are prepared. Hardware manufacturers, software firms, and telecommunication companies would need to improve product reliability to limit the defects in their wares, expand technical support to teachers, increase speed of Internet connection at little cost to schools, and test software on consumers prior to marketing them to district and state administrators. Without such major changes, only modest, peripheral modifications will occur in schooling, teaching, and learning. Teachers will adapt innovations to the contours of the self-contained classroom. New technologies will, paradoxically, sustain old practices (Cuban et al., p. 25).

However, I also found that technology trailblazers and the technology director have the ability to facilitate change and have begun to alter the organizational structure of this high school (p. 25). Examples of innovative, revolutionary changes in classrooms are rare, but ought not be dismissed. They invite optimism about the future of educational technologies and suggest that, despite organizational and occupational barriers to teachers' willingness to change their pedagogies, change can and does occur.

Although a great deal of literature exists on the challenges of technology implementation in the education system, further research is needed to examine the role of technology directors in other schools to see if my results can be replicated. My study is useful in that it closely examines

the complexities of one particular case, but my findings are not generalizable due to my small sample size. Researchers in the future should take care to acquire a representative sample, with teachers from various departments, in order to understand how the dynamics change across departments. Future studies should also involve ethnography in order to confirm that "technology trailblazers" are, in fact, using technology in unconventional yet effective ways. In addition, further research might examine the technology director as a "tertius iungens," or a generous broker who uses his or her position of power to spread rather than conceal information (Obstfeld, 2005). A network analysis of employees within a school could also uncover further complexities of the technology director's position and clarify the type of relationship that he or she has with the teachers, the technology staff, and the administration.

This study contributes to the current understanding of education reform and pedagogical change by integrating existing theories and observing how they manifest in the real world. While it may take time for a technology revolution to occur in high schools, I disagree with Cuban, Kirkpatrick, and Peck's (2001) conclusion that it is unlikely. If researchers can develop a deeper understanding of the technology director's bird's eye view, they can suggest ways that schools can utilize this new resource in order to improve implementation efforts. My findings suggest that policymakers focus more on facilitating peer diffusion rather than continuing to use top-down strategies of implementation. Change will take time and may occur by diffusion rather than top-down implementation, however, I believe that classrooms in the future will adapt and find ways to use educational technologies in interesting and meaningful ways.

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APPENDIX

Interview Questions-Technology Staff

1. Describe the use of technology in your everyday life.
2. In what ways do you think that technology could enhance a student's education?
3. What technologies are available to teachers? Do all teachers have access to the same technologies?
4. Do most teachers take advantage of these resources?
5. What forms of technology (if any) do you see teachers using in their classrooms on a day-to-day basis? Weekly basis? Monthly basis?
6. How did they gain access to these technologies? Are efforts to acquire new technologies largely independent and individual, or are they department/school-wide?
7. Do teachers in different departments utilize technology in similar ways? Explain.
8. Describe any technology training available to teachers at SCHOOL (specifically the Special Ed, Math, and Science departments)
9. If teachers encounter technical difficulties, where should they go for help? Do you think that they are aware of the resources that exist?

10. Describe any situations in which a teacher has come to you with an idea for gaining access to a new technology resource. What kinds of challenges did they face in this process? Did they end up being successful in their endeavor?
11. Describe the school's general attitude towards the use of technology in the classroom.
12. What are some of the strengths of this school (compared to others in the state/country) regarding support for technology?
13. What improvements could be made regarding the school and its support for technology use? What kinds of resources would you need to implement these improvements?

Interview Questions-Teachers

1. In what ways do you think that technology could enhance a student's education?
2. Describe the use of technology in your everyday life.
3. Describe your process when preparing for a new school year; do you tend to change your curriculum or does it remain more or less consistent?
4. What forms of technology (if any) do you use in your classroom on a day-to-day basis? Weekly basis? Monthly basis?
5. How did you gain access to these technologies?
6. Do other teachers in your department utilize technology in a similar way? Explain.
7. Do teachers in other departments utilize technology in a similar way?
8. Describe any training you have received from your department or the school regarding the use of these technologies.
9. If you encounter any technical difficulties, who would you go to for help?
10. Is assistance readily available?
11. Are there any technologies that you would like to incorporate into the classroom but currently do not have access to? If so, what kinds of barriers prevent you from implementing new technologies in the classroom? (lack of training, resources, time, interest)
12. Would you use technology more in the absence of these barriers?
13. If you were to have an idea for some way to incorporate a new technology, would you know where to get funding (who to talk to, how to apply for a grant, etc.)?
14. Do you feel that anyone would support you in this pursuit, or would it be mostly an independent endeavor?
15. If you had more support, would you be more likely to follow through
16. Do you know how to apply for grants? Does this training come from the district or department?

Full List of Codes

1. Age and technology use
2. All teachers have access to same technologies
3. Change is inevitable
4. Cross-training
5. Delivery method of new material
6. Different goals
7. Enthusiasm

8. Fast pace of technological change
9. Fear
10. Financial considerations
11. Frustration
12. Group endeavor
13. Help Desk increases efficiency
14. Help Desk non-use
15. Help Desk to prove worth
16. Help is available
17. Hierarchy bottom-up
18. Hierarchy top-down
19. Inability to change
20. Independent endeavor for new technologies
21. Individual preferences
22. Individual tech savviness
23. Lack of communication
24. Lack of confidence
25. Lack of time for learning something new
26. Laptop for every student
27. Non-mandatory training
28. Pace of learning
29. Peer diffusion
30. Resistance
31. School vs. Business
32. SharePoint steep learning curve
33. Size makes decisions difficult
34. Social networks
35. Teachers take advantage of technology
36. TechDirector teacher bad
37. TechDirector teacher good
38. Technology creates connection
39. Technology doesn't fit with classroom
40. Training is available
41. Unilateral thought
42. Varying departmental needs
43. Web filtering
44. Work load

Table 4: Code Frequencies

Code	Total	Min	Max	Mean	Std Dev	Bar Graph
enthusiasm	46	0	21	5.111	6.566	
help is available	44	0	13	4.889	4.076	
Financial considerations	40	1	8	4.444	2.506	
lack of communication	38	0	12	4.222	4.631	
Work Load	37	0	9	4.111	2.804	
frustration	33	0	16	3.667	4.924	
hierarchy top-down	23	0	6	2.556	2.351	
Peer diffusion	22	0	9	2.444	2.744	
Delivery method of new material	20	0	7	2.222	2.167	
Age and technology use	18	0	5	2	1.871	
fast pace of technological change	18	0	6	2	2.398	
different goals	16	0	7	1.778	2.438	
Help Desk non-use	15	0	4	1.667	1.414	
change is inevitable	12	0	4	1.333	1.323	
cross-training	12	0	3	1.333	1.225	
independent endeavor for new technology	12	0	5	1.333	1.658	
Individual tech savviness	13	0	6	1.444	2.128	
Teachers take advantage of technology	12	0	3	1.333	1.414	
technology creates connection	12	0	5	1.333	1.658	
Training is available	12	0	5	1.333	1.803	
hierarchy bottom-up	11	0	8	1.222	2.635	
non-mandatory training	11	0	5	1.222	1.641	
varying departmental needs	11	0	4	1.222	1.394	
inability to change	10	0	3	1.111	1.453	
Laptop for every student	10	0	4	1.111	1.364	
Resistance	9	0	3	1	1.118	
social networks	8	0	8	0.889	2.667	
Lack of time for learning something new	7	0	4	0.778	1.394	
group endeavor	5	0	2	0.556	0.882	
Help Desk to prove worth	6	0	2	0.667	0.866	
lack of confidence	6	0	2	0.667	0.707	
School vs. Business	6	0	5	0.667	1.658	
size makes decisions difficult	5	0	2	0.556	0.882	
TechDirector teacher good	6	0	5	0.667	1.658	
unilateral thought	5	0	3	0.556	1.014	
web filtering	6	0	6	0.667	2	
fear	4	0	2	0.444	0.726	
individual preferences	3	0	2	0.333	0.707	
Pace of learning	3	0	1	0.333	0.5	
SharePoint steep learning curve	3	0	1	0.333	0.5	
All teachers have access to same technologies	1	0	1	0.111	0.333	
Help Desk increases efficiency	1	0	1	0.111	0.333	
TechDirector Teacher bad	2	0	2	0.222	0.667	
Technology doesn't fit with classroom	2	0	2	0.222	0.667	
Total: 44	**596**					Export... Print...