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Formal Change Processes and Informal Teacher-Initiated Change Processes: A Longitudinal Case Study of Technology Integration at an Elementary School

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FORMAL CHANGE PROCESSES AND INFORMAL TEACHER-INITIATED
CHANGE PROCESSES: A LONGITUDINAL CASE STUDY OF
TECHNOLOGY INTEGRATION AT AN ELEMENTARY SCHOOL

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
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in

The School of Education

by

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Dedicated to my family, co-workers, and Cade

whose combined and continued love and support helped me through
this very long and challenging process. Thank you for giving me
the support and time I needed and never allowing me to give up.
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ABSTRACT

Although teachers and students in nearly every classroom have access to technology, for various reasons many teachers are unable to integrate technology successfully into their classroom instruction. The primary purpose of this longitudinal, qualitative case study was to investigate how formal change processes and informal teacher-initiated change processes facilitated technology integration at a small, private school in the southeastern United States. The change processes investigated were (a) formal professional development (b) informal job-embedded professional development, (b) informal communities of practice, and (c) informal teacher leadership. The secondary purpose was to investigate changes in teaching that resulted from technology integration at the study school.

The participants were six teachers who taught grades three, four, and five and the principal, all of whom worked at school during the first six years of technology integration, when the data were collected. Interview were collected from teachers in 2008, 2010, and 2011 and from the principal in 2011. All interview data were transcribed and analyzed using the constant comparative method and utilizing the ATLAS.ti coding program.

The findings indicated that the change process to integrate technology was initially facilitated by the principal through the formal professional development she made available to teachers. Technology integration was then sustained and driven forward by the informal teacher-initiated change processes. Based on the data from each round of teacher interviews, teachers were located on two scales, the Stages of Concern and the Levels of Use (Hall & Hord, 2006), that gauge progress during a change process. These scales showed steady progress for all six teachers.
Positive changes also occurred regarding teaching and learning. The teaching environment transformed from one in which technology was occasionally used to one in which technology was used extensively, students were more engaged, classrooms became student-centered, and teachers could better differentiate learning.
CHAPTER 1. INTRODUCTION

Twenty-first century technology is making its way into many classrooms causing the effective use of technology to be one of the central issues in education (National Center for Educational Statistics [NCES], 2010). NCES (2010) conducted a national survey of public school teachers on the availability of computers, other technology devices, and the internet as well as on teachers’ use of these resources for instruction. The findings about the instructional use of technology reported by NCES, bulleted below, are cause for concern.

- Ninety-seven percent of teachers had one or more computers located in the classroom every day, while 54 percent could bring computers into the classroom…. Internet access was available for 93 percent of the computers located in the classroom every day and for 96 percent of the computers that could be brought into the classroom. The ratio of students to computers in the classroom every day was 5.3 to 1.

- Teachers reported that they or their students used computers in the classroom during instructional time often (40 percent) or sometimes (29 percent)…. Teachers reported that they or their students used computers in other locations in the school during instructional time often (29 percent) or sometimes (43 percent).

- Teachers reported having the following technology devices either available as needed or in the classroom every day: …interactive whiteboards (28 percent [available as needed] and (23 percent [in the classroom every day]…), and digital cameras (64 percent [available as needed] and 14 percent [in the classroom every day]…). Of the teachers with the device available, the percentage that used it
sometimes or often for instruction was…57 percent for interactive whiteboards, and 49 percent for digital cameras. (NCES, 2010, p. 3)

The NCES (2010) results indicated that although nearly all classrooms have access to technology, the percentage of teachers who use the technology for instruction is substantially lower. As the NCES findings indicate, having access to various technologies is insufficient for these resources to be integrated into teaching and learning in a large proportion of the nation’s classrooms. This finding has important implications for student learning. Prensky (2001) explained that having grown up with technology, “today’s students think and process information differently from their predecessors” (p. 1). This difference in thinking and processing information creates a disconnect for students who are expected to learn primarily from traditional teaching techniques at school, while outside of school, they learn from an array of widely available technology devices.

Categories of Technology Users

Important to the study reported here are change processes that can be used to minimize the disparity between technology availability and technology use found in the NCES (2010) study. Helpful to understanding why some teachers use the available technology and other teachers do not is a scheme initially proposed by Prensky (2001) and later expanded by Freyer (2006) to categorize technology users. Prensky coined the terms digital natives and digital immigrants to identify two categories of technology users. Digital natives grew up using computers, video games, and the internet as normative activities in daily living. This familiarity makes them native speakers of the digital language (Prensky, 2001). Conversely, digital immigrants usually grew up prior to the advent of home computers, the internet, and other technologies (Prensky, 2001). Digital language is foreign to them.
While digital immigrants do learn to use those technologies they find useful in their lives, they often ignore or are unaware of other technologies (Hammonds, Matherson, Wilson, & Wright, 2013). Further, digital immigrants may not take full advantage of the capabilities of the technologies they do use (Mishra, Koehler, & Kereluik, 2009). For example, a digital immigrant may learn to use a software program proficiently to send email messages, but takes no interest in learning to use other program features such as the appointment calendar. Digital immigrants, according to Prensky (2001), are “like all immigrants… [in that] some better than others…adapt to their environment” (p. 2). Nonetheless, like all immigrants, digital immigrants “always retain, to some degree, their ‘accent,’ that is, their foot in the past” (Prensky, 2001, p. 2).

The concept of digital immigrants and digital natives, though interesting, does not explain how some teachers who, despite having grown up before technology came into wide use, have overcome the constraints of being digital immigrants and successfully integrate technology in their work with students. Education technology blogger and researcher, Fryer (2006) addressed this gap by introducing other categories of technology users. Most applicable in context of this study is the category Fryer termed digital bridges. Digital bridges are “neither truly natives nor fully digital immigrants” (Fryer, 2006, p. 1); rather, they “have both native and immigrant traits” (p. 1), allowing them to “communicate relatively effectively with both groups” (p. 1). Digital bridges might not have grown up using technology, but they recognize the benefits technology offers to effective teaching, become interested, and take it upon themselves to learn and use various technologies. Together, these three categories of technology users are usually found on every faculty and represent the varying levels of competence among faculty members in using technology as a medium of instruction. Consequently, while technology integration is an
innovation to one teacher, it is unremarkable to another (Sahin, 2006), a point of some importance to any change process used to integrate technology into daily instruction.

An advocate of technology integration to convey content and to foster critical thinking more effectively, Prensky (2001) advised that education professionals “reconsider both our methodology and our content” (p. 3). Reconsidering one’s instructional methodology to integrate technology can be daunting and time consuming for teachers who are digital immigrants. Nevertheless, the teacher participants in this study took Prensky’s advice and rethought both their instructional methodologies and the role of technology in their teaching. The result was successful technology integration.

**Statement of the Problem**

Schools are responsible, to a substantial extent, for integrating various technologies seamlessly into instruction (Mishra, Koehler, & Kereluik, 2009) if students are to be prepared to compete successfully in the information age and knowledge economy. Doing so requires teachers who are not only proficient with these technologies, but who also maintain their proficiency as technologies change (Mishra et al., 2009). According to the School and Staffing Survey conducted by NCES (U.S. Department of Education, 2011-2012), 15.5 percent of teachers nationwide are younger the 30 years of age while almost twice as many, 31.3 percent, are age 50 and over. These data indicate that approximately one-third of the nation’s teachers can be classified as digital immigrants (Prensky, 2001), and, therefore, will need sustained professional development to support the integration of technology into their teaching (Mishra et al., 2009).

Much of the available research supporting technology integration focuses on providing specialized personnel such as master teachers (Wright & Wilson, 2007), mentor teachers
(Kopcha, 2010), and technology facilitators (Broussard, 2006). Studies that investigate facilitating technology integration through job-embedded professional development (JEPD), such as that which would occur through school-based communities of practice, are few in number. Moreover, researchers who do explore communities of practice, study those that were formally established by school or district leaders (Vavasseur & MacGregor, 2008; Kopcha, 2012). The present study addresses that void in the research by focusing on informal collaboration initiated by teachers at one school. This study makes a further contribution by investigating the means by which formal professional development implemented and supported by the principal fostered informal JEPD among teachers whose collaborative efforts grew into teacher-initiated informal communities of practice in response to needs teachers identified as they undertook technology integration.

**Purpose of the Study**

The primary purpose of this study was to investigate the instrumental role played by teachers at a small, private elementary school in shaping a change process that facilitated successful implementation of an innovation. The innovation, technology integration in daily instruction, was adopted by the school’s governing board in 2006, and included the requirement that all teachers at the school adopt the change. The secondary purpose of the study was to examine teacher perceptions of the changes in teaching and learning that resulted from technology integration. The study is informed by and builds on prior research the author (Brownfield, 2008) conducted at the school to explore implementation of this innovation. Findings from the Brownfield study indicated that teachers, with the support of school principal, developed informal change processes to respond to problems that surfaced as technology
integration was implemented. Together, the formal change processes and the informal teacher-initiated change processes facilitated technology integration.

Important to the purpose of this study is that while technology integration was mandated, no structured change process was specified. Instead, the governing board proactively provided three sources of support for teachers; extensive professional development during the summer preceding implementation, opportunities to participate in ongoing professional development, and the addition of an assistant technology coordinator to the school staff. Although both the professional development and the new assistant technology coordinator were helpful to teachers (Brownfield, 2008), neither sufficiently met teachers’ need for JEPD. As a consequence, Brownfield found that when teachers encountered an implementation problem, they collaboratively devised an action to address it and, in doing so, developed their own teacher-initiated change processes.

These formal change processes and informal teacher-initiated change processes included (a) formal professional development (b) informal JEPD, (c) informal communities of practice, and (d) informal teacher leadership. Over time, use of these four processes led to changes in the ways teachers interacted, which, in turn, fostered teachers’ commitment to integrating technology into their classrooms. Collectively, the teacher-initiated change processes came to comprise an effective, home-grown approach to change that was organic (Hatch with Cunliffe, 2006) rather than mechanistic, and evolutionary rather than pre-planned. This study investigates the development and evolution of the formal and informal teacher-initiated change processes, including a steadily increasing sophistication in teachers’ use of the change processes which contributed to a tightly linked interconnection among them.
Significance of the Study

A search of the literature found no studies that investigated informal teacher-initiated change processes related to technology integration, nor were any studies located in which teachers developed responses to obstacles encountered during implementation of a technology integration innovation. Research in other areas, however, found that teacher-initiated JEPD in the form of collaboration between colleagues improved the capacity of teachers to integrate literacy strategies (Thibodeau, 2008). Likewise, collaborative work among social workers has led to similar improvements in capacity (Iseminger & Donaldson, 2011). As noted, previous education technology researchers focused on formalized JEPD and reported that in-house technology staff and facilitators (Broussard, 2006; Reinhart, Thomas, & Toriskie, 2011) and collegial support (Frank, Zhao, & Borman, 2004; Penuel, Frank, Sun, Kim, & Singleton, 2013; Sahin & Thompson, 2006; Shapley, Sheehan, Sturges, Caranikas-Walker, Huntsberger, & Maloney, C, 2006) were important factors in the success of technology integration. The purpose of formalized initiatives was to change perceptions (Sahin & Thompson, 2006) and increase proficiency (Shapley et al., 2006), while the purpose of the informal JEPD explored for the present study was to solve problems collaboratively. Moreover, prior research does not connect technology facilitators who are members of the school staff or collegial support to a progression that ends with teacher-initiated communities of practice.

Based on her review of literature, MacDonald (2008) called for additional research about communities of practice. Subsequently, researchers conducted such studies and found communities of practice to be beneficial. Teachers shared ideas and gained knowledge through both online (Vavasseur & MacGregor, 2008) and within school (Kopcha, 2010; Kopcha, 2012) communities of practice. Further, teacher attitudes toward technology integration improved in
these studies (Kopcha, 2010; Kopcha, 2012; Vavasseur & MacGregor, 2008). Because these studies concentrated on JEPD that took place in formal communities of practice, opportunities for informal teacher leaders to emerge may have been limited.

Researchers interested in teacher leaders studied teachers who held both formal and informal roles. Holahan (2000) and others (Staples, Pugach & Himes, 2005; Sahin & Thomson, 2006) examined the role formal teacher leaders, such as master teachers, facilitators, and coordinators, played in facilitating technology integration. Angelle and her colleagues (Angelle, 2010; Angelle & DeHart, 2011; Angelle, Nixon, Norton, Niles, 2011; Angelle & Teague, 2011) studied informal teacher leadership and the conditions under which it thrived. The focus of these researchers was generalized rather than focused on technology integration.

The studies mentioned in the preceding sections provide evidence that formal professional development, informal JEPD, informal communities of practice, and informal teacher leadership can facilitate technology integration. Nevertheless, these studies fail to examine the interconnectedness and origins of these informal teacher-initiated change processes. Therefore, the present study begins to fill those gaps in the educational technology literature and to provide insight into how teacher-initiated change processes can contribute to technology integration into instruction. Two models, a change process model and conceptual model of the change process at the school, are proposed in Chapter 4 to depict the interconnections among the formal and informal change processes, providing insights about the change process that are broadly applicable to school and non-school settings.

**Overview of the Study**

This study makes a useful contribution to the literature by documenting the evolution of a change process as it unfolded over a six year period. Prolonged engagement (Creswell, 2007)
and multiple data collection points gave breadth and depth to the study. To explore the various processes teachers undertook to integrate technology into instruction, a longitudinal, descriptive case study (Yin, 2003) was designed. Data collection occurred over the span of six years with data collected at three points in time (Hostetler, 2006; Zhao et al., 2001). Individual qualitative interviews (Hermanowicz, 2013) were conducted with teachers who taught in grades three through five and one interview was conducted with the principal. For each round of data collection, a semi-structured interview protocol (Cohen et al., 2010; Newton, 2010) was constructed to obtain teachers’ thoughts, perceptions, and reflections about the technology integration innovation, successes and challenges related to implementation, actions taken to resolve those challenges, and instructional changes that resulted from the change process. The interview conducted with the principal took place during the last year of the study period to provide confirming and disconfirming data from the perspective of an added stakeholder.

The site at which the study was conducted was a small, private elementary school located in the capital city of a southeastern state. The school was attended by approximately 300 students in Pre-K through fifth grade, most of whom were white. The school faculty included 20 classroom teachers, most of whom were also white. Making this school a particularly interesting and appropriate research site was that the technology plan adopted by school governing board, mentioned earlier, was well thought out and ambitious. Implementation of the plan began with extensive professional development in the summer of 2006.

As would be expected based on Prensky’s (2001) concept of digital natives and digital immigrants and Fryer’s (2006) concept of digital bridges, a wide variation in teachers’ level of technology proficiency was evident as the new school year started despite the summer professional development program. Nevertheless, the faculty began to integrate technology in
their classrooms and to devise individually distinctive techniques to augment their technology-related knowledge and skills. With the support and assistance of the principal, teachers who were digital immigrants sought the assistance of their digital native and digital bridge colleagues who were successfully integrating technology. These colleagues responded with generosity, sowing the seeds of the informal teacher-initiated change processes that developed and contributed substantially to the success of the technology plan.

**Locating the Researcher in the Study**

As part of a technology plan adopted by the school governing board, I was hired as the assistant technology coordinator for the school and as the technology teacher for a new computer lab. These duties began with the start of the 2006 fall semester and I have now been employed at the school for 8 years. Thus, my role as researcher is similar to that of a participant observer (Jorgenson, 1989).

Initially, the participants and I did not know each other; however, my responsibilities quickly led to familiar professional relationships. As time progressed, teachers and administrators viewed me as a member of what became commonly referred to as the tech team. In this multi-faceted role, I facilitated teacher professional development, provided advice to teachers about student projects, worked with school communication activities, and taught weekly technology classes for students. In addition, my responsibilities included troubleshooting technology problems, maintaining the school website, and assisting with school electronic communications.

My employee role at the school and my researcher role in conducting this study raised the issue of researcher bias in this study (Creswell, 2007; Unluer, 2012). Several steps were taken to reduce this bias. First, to minimize the potential for leading the participants to certain responses
during the interviews, an interview protocol developed (Creswell, 2007) for each round of data collection was used with all six teacher participants. Protocol questions were written and open-ended to avoid guiding participants toward a particular response. Second, I was mindful of my own prejudices (Unluer, 2012), aware of my responsibility as a researcher to remain neutral, and careful to avoid making any comments, gestures, or facial expressions that could influence a teacher’s response. Further, all of the teachers at each of the three grades level included in the study were interviewed to maximize variation (Creswell, 2007) and gain the viewpoints of all teacher participants. Third, no protocol items addressed my role at the school to reduce any bias from personal feelings a teacher might have had.

The insider information (Herrmann, 1989) that accrued from my work responsibilities was augmented by a case study that I conducted at the school (Brownfield, 2008) during the second year of implementation. The present study built on that research, as mentioned previously. Three finding from the earlier study contributed in substantial ways to the present study. One finding was that the veteran, digital immigrant teachers expressed an appreciation for their digital native and digital bridge colleagues who voluntarily helped them integrate technology in their instruction, thus providing informal JEPD. A second finding contributing to the current study was that teacher collaboration evolved into communities of practice in which the teachers collectively helped one another traverse the long and unfamiliar path of technology integration. The communities of practice grew and matured over time providing richer, more probing JEPD than was available through one-on-one collaboration. The third finding that contributed to present study was that teacher leadership opportunities emerged from the communities of practice. Younger teachers, who were digital natives, and older, more experienced teachers, who were digital bridges, often acted as mentors to their digital immigrant
colleagues and took active roles in leading the work of the communities of practice. These findings provided a foundation for the present study.

**Conceptual Framework**

Hall and Hord (2011) describe the change process as “a process through which people and organizations move as they gradually learn, come to understand, and become skilled and competent in the use of new ways” (p. 8). Inherent in a change process is that something new, that is, an innovation, is implemented. Change is exceptionally difficult regardless of the setting in which it takes place (Hall & Hord, 2006) and, in schools, implementing change successfully has proven especially difficult. As Hall & Hord (2006) noted, many, if not most, change efforts in schools fail. Among the obstacles precipitating this failure is teacher distrust of the proposed innovation. Most teachers, having taught a certain way for years, are reluctant to give up the familiar methods they are comfortable using (Zhao et al., 2002) to substitute new, unfamiliar methods about which they are uncertain and perhaps suspicious (Sahin, 2006). Distrust, uncertainty, and suspicion, then, are impediments to be overcome for a change process to be successful.

Uncertainty was the main obstacle of concern in the present study. Teachers at most private schools in the state, including the one in this study, sign an employment contract annually. The employment contract for the 2006-2007 school year contained a provision committing teachers who signed the contract to technology integration; thus, distrust and suspicion were mitigated to some extent. However, for many teachers, particularly those who were digital immigrants, uncertainty was not assuaged by the employment contract. To shed light on how these teachers overcame their uncertainty, as well as their knowledge and skill
deficits regarding the innovation, the Concerns-Based Adoption Model (Hall & Hord, 1987) was used as the conceptual framework of this study.

**Concerns-Based Adoption Model**

Hall and Hord (1987) worked extensively with change processes and innovation implementation in both education and business settings. Based on their accumulated knowledge and experience, they developed the Concerns-Based Adoption Model (CBAM). Among its components, CBAM includes two measures designed to help organization leaders assess the extent to which each member of the organization feels comfortable with and is actively involved in implementing an innovation. One measure, Stages of Concern (SoC), describes affective responses, or feelings, individuals experience when involved in a change process. The other measure, Levels of Use (LoU), describes observable behaviors individuals exhibit during the implementation of a innovation (Hall & Hord, 2006). Together, these scales provide leaders with information that can be used to target appropriate assistance to each individual.

Seven stages comprise the Stages of Concern and range from SoC 0 Unrelated, indicating the individual, or teacher for purposes of this study, has almost no knowledge about or feelings toward the innovation, to SoC 7 Refocusing, indicating that positive effects of the innovation are abundantly evident in student learning, thereby prompting the teacher to seek greater benefits, perhaps from “a more powerful alternative” (Hall & Hord, 2006, p. 140).

The Levels of Use scale includes eight levels, ranging from LoU 0 Nonuse, indicating that the teacher “exhibits no behavior related to” the innovation (p. 160) and has to interest in learning about it, to LoU VI Renewal, signifying that the teacher is interested in an “alternative…to achieve increased impact” (p. 160) on students. As evident from this brief description, the stages and levels parallel one another to some degree.
The research reviewed for this study, including research on CBAM, pointed out several elements of a change process that support implementation of an innovation at a school. Therefore, the CBAM model was an appropriate conceptual framework to study change processes used at the school to implement technology integration.

**Model of Technology Integration**

The present study extended prior research by demonstrating that formal change processes and informal teacher-initiated change processes used at the study school co-existed in a complex, interconnected relationship that led to schoolwide technology integration. The relationships among these formal and informal change processes are presented in the Formal and informal change process model shown in Figure 1.1.

![Figure 1.1. Formal and informal change process model](image)

The preliminary model depicts a change process in which each component drove and was driven by the others, resulting in technology integration. In turn, the model proposes that technology
integration became a driver in sustaining use of the change processes. The model and its four components are explained below.

**The Model and its Components**

The preliminary formal and informal change process model is comprised of five components; formal professional development, informal JEPD, informal communities of practice, informal teacher leadership, and technology integration. These components are depicted metaphorically as gears for two reasons. The first reason is that gears demonstrate the interconnectedness of the five components. The second reason is related to the purpose of gears; when gears engage, force is produced and movement occurs. Thus, as the change processes and technology integration engage, sufficient force is produced for teachers to make the moves necessary for innovation implementation to occur.

**Formal professional development.** The first change process in the model is formal professional development provided by outside experts. Formal professional development utilizes in-service teacher training (Karmeshu, et al., 2012) focused on skills related to a specific innovation. Formal training opportunities are most effective when they emphasize topics relevant to the participants and their specific school environment (Frank et al., 2011; Vanderlinde & van Braak, 2011).

**Informal JEPD.** Job-embedded professional development (JEPD) is strategy for providing continuous professional development by utilizing the expertise of teachers at the school to work in the classroom with colleagues during the course of the work day (Croft, Coggshall, Dolan, & Powers, with Killion, 2010; Darling-Hammond & McLaughlin, 1995; Hirsh, 2009). A digital bridge, for example, might co-teach a lesson with a digital immigrant to work through a specific problem related to using an interactive whiteboard. The purpose of
JEPD is to enhance student learning by providing opportunities for teacher learning that is authentically “grounded in day-to-day teaching practice” (Croft, et al., 2010, p. 2). According to Hannafin and Hill (2007), JEPD has its theoretical basis in constructivism because the “individuals are active learners and control their own learning process” (p. 59). Consistent with constructivist theory, Hannafin and Hill (2007) suggested that JEPD offers an opportunity for “the learner [to] also [be] a designer, not merely a receiver of designed material and activities” (p. 59).

JEPD can be an individual undertaking (Hannafin & Hill, 2007), but it is more often collaborative in nature (Wilson, 1996), such as in communities of practice (Wei et al., 2009). JEPD is often a formal arrangement (Broussard, 2006), such as when a change facilitator is hired to assist teachers in their classroom with implementing an innovation. Less often, JEPD occurs informally through shared work experiences and social interactions (Iseminger & Donaldson, 2011) as it did in the present study. When teachers encountered difficulties using the technology, an opportunity was created to learn through collaborating and participating with peers. Regardless of format, formal or informal, quality professional development is crucial to innovation implementation (Armstrong, Barnes, Sutherland, Curran, Mills, & Thomson, 2005; Broussard, 2006; Frank et al., 2011; Karmeshu, Ramen, & Nedungadi, 2012) because it builds teachers’ knowledge and skills.

**Informal communities of practice.** A third change process identified as driving technology integration was informal communities of practice. A common thread in the change process and technology integration literatures is a need for support from and collaboration with one’s colleagues (Sahin & Thompson, 2006; Shapley et al., 2006). Communities of practice, also known as professional learning communities (PLCs) (Wei, Darling-Hammond, Andree,
Richardson, & Orphanos, 2009), are small, collaborative workgroups of teachers that provide the support and collaboration which Sahin and Thompson (2006) encouraged. Additionally, MacDonald (2008) identified communities of practice as an “effective ICT (information and communications technology) integration practice” (p. 439). Whether technology oriented or not, community members meet frequently to discuss and resolve classroom problems, to confer about implementing an innovation, and to share effective instructional techniques (Wei et al., 2009). Quintessential to the purpose of communities of practice is that members share a common interest in “something they do and learn how to do it better as they interact regularly” (Wenger, 1998, p. 1). At the core, communities of practice are focused on improving the instruction of all members as the route to improving student learning.

**Informal teacher leadership.** The fourth and final change process identified as driving technology integration was informal teacher leadership. Pounder (2006) and Angelle (2010) reported that teacher leadership often involves teachers leading in an informal capacity. These informal teacher leaders can become transformational leaders who inspire their followers, bringing them to higher levels of commitment and performance (Pounder, 2006; Angelle, 2010). The potential for informal teacher leaders to be transformational leaders is enhanced through collaboration, shared vision, and common goals for school excellence (Angelle & DeHart, 2011). In addition, when the best interest of students is central to the work of teacher leaders, mutual trust and strong, positive collegial relationships are built (Angelle, 2010; Angelle & DeHart, 2011; Angelle & Teague, 2011; Angelle et al., 2011).

**Technology integration.** This aspect of the model served the dual roles of being both the impetus for and the result of the interaction of the other model components. That is, technology integration was the impetus for formal professional development, informal JEPD,
informal communities of practice, and informal teacher leadership to develop. However, as teachers met with success in using the technology, continuous improvement in their skill with technology integration resulted from the use of other four model components. Success with technology integration led teachers to experiment with new collaboratively developed, technology-centered projects. The meshing of all five gears in the model spurred the change process forward, raising teachers’ location on the Stages of Concern and Levels of Use (Hall & Hord, 2006). The technology integration gear is bigger than the others because of its dual roles instigating and then driving forward the formal and informal change processes.

**Definition of Terms**

A number of terms discussed in this study warranted definition to clarify their meaning. These terms are defined next.

- A change process is “a process through which people and organizations move as they gradually learn, come to understand, and become skilled, and competent in the use of new ways” (Hall and Hord, 2011, p. 8). The process was captured in this study as teachers moving from lower Stages of Concern and Levels of Use to higher Stages of Concern and Levels of Use (Hall & Hord, 2006). The change process was considered “a process, not an event” that “transpire[d] over time altering the feelings teachers experience[d] about an innovation and their competence in its use” (Hall & Hord, 2006, p. 4).

- Technology integration is “the incorporation of technology resources and technology-based practices into the daily routines, work, and management of schools” (NCES, 2002, p. 75).
Research Design and Research Questions

A descriptive case study (Creswell, 2007; Yin, 2003) design involving qualitative methods and prolonged engagement (Fetterman, 1998, p. 46, in Creswell, 2007) was used to explore the formal and informal change processes teachers at a small, private elementary school developed to integrate technology into their instruction. A descriptive case study design was appropriate because this study used “an intervention or phenomenon and the real-life context in which it occurred” (Yin, 2003, in Baxter & Jack, 2008, p. 549). The study consisted of teacher interview data collected at three points over six years and one interview with the school principal. The following research questions guided the study.

1. How did formal change processes and informal teacher-initiated change processes facilitate the changes necessary for technology integration?
   a. How was the change process facilitated by formal professional development?
   b. How was the change process facilitated by informal JEPD?
   c. How was the change process facilitated by informal communities of practice?
   d. How was the change process facilitated by informal teacher leadership?

2. What changes did teachers perceive in teaching and learning as a result of technology integration?

Delimitations and Limitations of the Study

The present study was delimited to a private, PK-5 elementary school located in the downtown area of a capital city in the southeastern United States. The participants of the study were delimited to the third through fifth grade teachers who taught at the school and principal. The time span of the study was delimited to the 2006-2007 school year, when technology
integration was initially implemented, through the 2011-2012 school year, when data collection ceased.

There are several limitations associated with this study. First, the researcher was the technology facilitator at the case study school and thus a member of the professional staff. Therefore, participant willingness to please the researcher in responding to interview questions may bias the data (Creswell, 2007). In addition, researcher bias may influence the data analysis and interpretation (Creswell, 2007). Moreover, because the study took place within one school, there could be factors unique to this school which affected the development of the formal and informal change processes, making it unlikely that the findings are transferable to other schools whether private or public.

Summary

The results of the NCES findings (2010) found a disconnect between teachers having access to technology and effectively utilizing this technology in their classrooms. This chapter established the need for further research concerning teachers as digital learners and the formal and informal change processes they used to integrate technology into their instruction. Also provided were an overview of the study and conceptual framework for the research.
CHAPTER 2: REVIEW OF RELEVANT LITERATURE

This study explored the change process by which technology was integrated into classroom instruction at a small, private elementary school over the span of six years. Prior research at the school (Brownfield, 2008) found that formal professional development combined with informal teacher collaboration were instrumental to the success of the change process. These collaborative efforts led to the development of informal teacher-initiated change processes that evolved over time and enabled the institutionalization of technology integration as normative practice. The change process included (a) formal professional development which complemented three informal teacher-initiated change processes, specifically, (b) informal job-embedded professional development (JEPD), (c) informal communities of practice, and (d) informal teacher leadership. Through use of these formal and informal change processes, technology integration was successful at the school.

Conceptual Framework

The conceptual framework for this study was the Concerns-Based Adoption Model (CBAM) developed by Hall and Hord (1987). CBAM has served as a guide to examining change processes in both education and business. Literature related to this model is reviewed below.

Concerns-Based Adoption Model

After accumulating approximately three decades of research about and practical experience in facilitating change in a variety of education and business settings, Hall and Hord (1987) designed CBAM. Their model differs from other change process models by focusing on the individual as the locus of change rather than on the group or unit. Based on their cumulative experience, these authors reasoned that “successful change starts and ends at the individual level.
Hall and Hord (2006) pointed out that “change is a process, not an event” (p. 4); that is, change transpires over time, often taking three to five years to become institutionalized. The feelings teachers experience about an innovation and their competence in its use vary over this time span. CBAM includes a measure of affective responses to, or feelings about, an innovation and a measure of the extent to which implementation is occurring. The Stages of Concern (SoC) measure teachers’ affective responses and are used to locate individual teachers on one of seven Stages of Concern: SoC 0 Awareness, SoC 1 Informational, SoC 2 Personal, SoC 3 Management, SoC 4 Consequence, SoC 5 Collaboration, and SoC 6 Refocusing (Hall & Hord, 2006). Levels of Use (LoU), on the other hand, are a measure of teachers’ behavior in implementing an innovation, and place teachers at one of eight Levels of Use: LoU 0 Nonuse, LoU I Orientation, LoU II Preparation, LoU III Mechanical Use, LoU IVA Routine, LoU IVB Refinement, LoU V Integration, and LoU VI Renewal (Hall & Hord, 2006). Both the Stages of Concern and the Levels of Use provide information that is useful in targeting assistance to a teacher during the change process. A brief description of the Stages of Concern and Levels of Use follows.

**Stages of Concern.** The seven Stages of Concern are not discrete, rather a teacher may experience concerns at more than one stage at a given time. Hall and Hord (2006) divided the Stages of Concern into four categories, including Unrelated, Self, Task, and Impact. The first category, Unrelated, is comprised of one stage, SoC 0 Awareness. At this stage, a teacher knows the innovation exists, but has no particular feelings about it. As the teacher learns more about
the innovation, s/he enters the second category, Self, which includes SoC 1 Informational and SoC 2 Personal. At SoC 1 Informational, the teacher is not only aware of the innovation, but also has an interest in the “general characteristics, effects, and requirements for use” (Hall & Hord, 2006, p. 140). When SoC 2 Personal is reached, concerns focus on the way the innovation affects the teacher individually, including sacrifices that may have to be made and benefits that may be derived (Hall & Hord, 2006).

When most concerns in the Self category are resolved, the teacher reaches the Task category and SoC 3 Management, an indication that the teacher is in the process of implementing the innovation. Attention is given to managing the “processes and tasks of using the innovation” (Hall & Hord, 2006, p. 140) and includes issues such as “organizing…scheduling, and time demands” (p. 140). This stage constitutes the middle Stage of Concern and is task-oriented rather than results-oriented. Once a teacher has mastered the procedures of implementing the innovation, s/he reaches a sequence of concerns which Hall and Hord (2006) categorize as Impact concerns.

The first Impact concern is SoC 4 Consequences. At this stage, concerns focus on the effect the innovation has on students. Consideration is given to possible changes that could serve the students more effectively. In an effort to make improvements, the teacher seeks the cooperation and help of others; an indication that the teacher has reached SoC 5 Collaboration. The final Impact stage, SoC 6 Refocusing, is attained when concerns shift to “more universal benefits from the innovation” (Hall & Hord, 2006, p. 140) and to “the possibility of major changes or replacement with a more powerful alternative” (p. 140). Although these stages are presented in a logical sequence, Hall and Hord (2006) emphasized that “most of the time a person will have intense concerns at more than one stage” (p. 142) and at more than one
category. The quality of professional development and extent of support provided determines whether the trajectory is sequential or not (Hall & Hord, 2006). In addition, these researchers noted that when multiple, conflicting reforms are mandated, a promising innovation can be undermined before the impact stages are reached.

**Levels of Use.** A second CBAM measure is Levels of Use (Hall & Hord, 2006). Comprised of eight levels that are divided into two categories, Nonusers and Users, the Levels of Use describe observable behaviors a teacher exhibits during the change process (Hall & Hord, 2006). The Nonusers category includes three levels, LoU 0 Nonuse, LoU I Orientation, and LoU II Preparation, while the Users category includes LoU III Mechanical Use, LoU IVA Routine, LoU IVB Refinement, LoU V Integration, and LoU VI Renewal (Hall & Hord, 2006). A teacher at LoU 0 Nonuse has neither knowledge of nor interest in the innovation. The next level, LoU I Orientation, describes behaviors associated with exploring the innovation, its value, and its demands (Hall & Hord, 2006, p. 160). At LoU III Preparation, the teacher engages in activities that lay the groundwork needed for implementation to begin.

Once a teacher begins innovation implementation, s/he reaches the category of Users and LoU III Mechanical Use. At this level, a teacher works to implement the basic tasks associated with the innovation. The teacher’s focus is narrowed to the day-to-day use of the innovation with little attention given to the impact of the innovation on students (Hall & Hord, 2006). This level corresponds to the Task category of the Stages of Concern, SoC Stage 3 Management. The next four Levels of Use, LoU IVA Routine, LoU IVB Refinement, LoU V Integration, and LoU VI Renewal, are somewhat analogous to the Impact category of the Stages of Concern.

A teacher who reaches LoU IVA Routine exhibits behaviors that indicate mastery of the innovation and the teacher’s use of the innovation has stabilized. No adaptations or modifications
are considered, however, until the teachers reaches LoU IVB Refinement. At this level, a teacher considers whether small to moderate changes will increase the effect on student learning (Hall & Hord, 2006) and experiments with adaptations. LoU V Integration occurs when teachers who made LoU IVB Refinement adaptations seek to collaborate with colleagues to achieve a more powerful impact on student learning. When a teacher reaches the highest level, LoU VI Renewal, major modifications of the innovation are investigated. If such modifications cannot be identified, the teacher may conclude that “to replace it altogether” (Hall & Hord, 2006, p. 164) is in the best interest of student learning. Each Stage of Concern and Level of Use is unique, important to the overall change process, and can be considered a sub-process within a larger change process (Hall & Hord, 2006). Table 2.1 shows a summary of and comparison between the Stages of Concern and Levels of Use.

The CBAM model (Hall & Hord, 2006) as well as the Stages of Concern and Levels of Use scales have been used to study teachers’ adoption of technology innovations. These technology innovations included computers in the classroom (Newhouse, 2001), one-to-one student computing initiatives (Donovan & Green, 2010; Donovan, Green, & Hartley, 2010), and professional development partnerships between universities and schools (Kaputska & Damore, 2009). An important finding in studies using CBAM was that collaboration was a key factor in moving educators to higher Stages of Concern (Foulger & Williams, 2007; Khobolo & O’Toole, 2011). Foulger and Williams (2007) reported that content area teachers found that “ongoing communications allowed higher risk levels, more reflective thought, and higher comfort levels which greatly impacted…instructors’ willingness to adopt new technology” (p. 112). Brownfield (2008) reported similar findings, noting that collaboration was an integral component of the informal JEPD and informal communities of practice in the study school.
Table 2.1 Comparison between the Stages of Concern and Levels of Use

<table>
<thead>
<tr>
<th>Stages of Concern</th>
<th>Focus on:</th>
<th>Levels of Use</th>
<th>Focus on:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact 6</td>
<td>Refocusing</td>
<td>Users VI</td>
<td>Renewal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Re-evaluates quality of use of innovation</td>
</tr>
<tr>
<td>5 Collaboration</td>
<td></td>
<td>V Integration</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Combines own efforts with related activities of colleagues</td>
</tr>
<tr>
<td>4 Consequence</td>
<td></td>
<td>IVB Refinement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Varies use of innovation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IVA Routine</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Use of innovation is stabilized</td>
</tr>
<tr>
<td>Task 3 Management</td>
<td></td>
<td>III Mechanical Use</td>
<td>Stepwise attempt to master tasks to use innovation</td>
</tr>
<tr>
<td>Self 2 Personal</td>
<td></td>
<td>II Preparation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Preparing for first use of innovation</td>
</tr>
<tr>
<td>1 Informational</td>
<td></td>
<td>I Orientation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Acquires information about innovation</td>
</tr>
<tr>
<td>Unrelated 0</td>
<td>Awareness</td>
<td>0 Nonuse</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Little or no knowledge of innovation</td>
</tr>
</tbody>
</table>

Note: Quoted from Implementing Change: Patterns, Principles, and Potholes, by G. E Hall and S. Hord, Copyright 2006 by Pearson Education.
As a conceptual framework, CBAM fostered both a deeper understanding of the formal and informal change processes that facilitated technology integration at the study school and a greater insight about why these processes were effective. Below, studies are reviewed in the context of formal and informal change processes, including formal professional development, JEPD, informal communities of practice, and informal teacher leadership.

**Change Processes**

Chapter 1 introduced a model depicting formal and informal change processes that are grounded in previous research at the study school (Brownfield, 2008). These included a formal change process supported by the principal and three informal teacher-initiated change processes developed in response to difficulties that arose as teachers implemented technology integration. The change processes, (a) formal professional development, (b) informal JEPD, (b) informal communities of practice, and (c) informal teacher leadership, promoted change and, through the collegial support inherent in these informal teacher-initiated change processes, addressed teachers’ Stages of Concern and Levels of Use.

**Formal Professional Development**

The first change process, formal processional development, was supported by the principal of the study school to facilitate technology integration. This section examines some of the relevant literature about formal professional development, especially studies that focus on technology integration, and the effect of professional development on implementing an innovation.

In 2008, the International Society of Technology in Education (ISTE) revised their National Educational Technology Standards (NETS) for teachers and technology leaders. These standards are to:
(1) Facilitate and inspire student learning and creativity
(2) Design and develop digital-age learning experiences and assessment
(3) Model digital-age work and learning
(4) Promote and model digital citizenship and responsibility, and

Evident in the ISTE standards is the importance of teachers to “continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community” (ISTE, 2008, p. 1).

The concept of continuously improving one’s practice is similarly reflected by Learning Forward, the national organization for professional learning, in their recently adopted professional learning standards. The Learning Forward standards state:

Professional learning that increases educator effectiveness and results for all students,
(1) Occurs within learning communities committed to continuous improvement, collective responsibility, and goal alignment,
(2) Requires prioritizing, monitoring, and coordinating resources for educator learning,
(3) Integrates theories, research, and models of human learning to achieve its intended outcomes,
(4) Aligns its outcomes with educator performance and student curriculum standards,
(5) Requires skillful leaders who develop capacity, advocate, and create support systems for professional learning,
(6) Uses a variety of sources and types of student, educator, and system data to plan, assess, and evaluate professional learning, and
(7) Applies research on change and sustains support for implementation of professional learning for long-term change (Learning Forward, 2011, p. 2).

These standards establish expectations and guidelines for student learning and teacher development. Learning Forward also stated that “the purpose of professional learning is for educators to develop the knowledge, skills, practices, and dispositions they need to help students perform at higher levels” (Learning Forward, 2011, p. 2). Therefore, professional development to aid technology integration should also have the goal of increasing teachers’ technology skills and confidence in using these skills in the classroom.
To meet the standards prescribed by Learning Forward (Learning Forward, 2011), the professional development literature suggested several factors that are met when integrating new technologies. These factors include teacher training (Frank et al., 2011; Karmeshu, Ramen, & Nedungadi, 2012; Vanderlinde & van Braak, 2011), sustained engagement and support (Armstrong et al., 2005; Frank et al., 2011; Liao, 2005; Neo & Calvert, 2012), and being site-specific (Bennison & Goos, 2010; Pan & Franklin, 2011; Uslu & Bumen, 2012).

**Training.** According to Karmeshu, Ramen, and Nedungadi (2012), the “crucial factor in the success of the adoption of personalized learning paradigm is the in-service TT [teacher training] program for the existing teachers” (Karmeshu, et al., 2012, p. 596). For teachers to adopt an innovation, training and instruction pertaining to the innovation is necessary so that individuals gain the knowledge and experience needed to reach higher Stages of Concern and Levels of Use (Hall & Hord, 2006). Several recent studies (Frank et al., 2011; Vanderlinde & van Braak, 2011) emphasized the importance of focused, thorough professional development programs which focus on imparting pertinent ideas to those who are integrating an innovation into their practice. For example, Vanderlinde and van Braak (2011) found evidence implicating the importance of a shared vision within a school implementing technology integration. In addition, the Vanderlinde and van Braak (2011) study revealed that the school vision and school policies were significant factors in teachers’ perceptions of the innovation, prompting the authors to recommend that schools focus on the teaching and learning process to foster adoption and implementation (p. 132). Frank, Zhao, Penuel, Ellefson, and Porter (2011) studied teachers’ use of computers during the initial year of integration in their classrooms. They hypothesized that “the more a teacher at the lowest initial levels of implementing an innovation is exposed to professional development focused on student learning, the greater the increase in the level of
implementation will be” (Frank et al., 2011, p. 141). According to the researchers, “the effect of focused professional development was statistically significant for those at the lowest levels implementation” (Frank et al., 2011, p. 149). Therefore, these studies suggest that if teachers perceive a change, such as technology integration, to be focused on student learning, they are more likely to become willing recipients of the training needed to begin integrating the innovation.

**Support.** In addition to receiving training that supported technology integration, educators must also have positive experiences using the innovations and adequate support for technology to become part of their everyday practice (Armstrong et al., 2005; Holahan et al., 2000). In their analysis of several case studies of teachers integrating technology, Armstrong et al. (2005) stressed the “importance of having long term, sustained engagement with new technologies” for teachers to successfully integrate technology, because “training and ongoing support is required for teachers” to adjust to new pedagogical approaches (Armstrong et al., 2005, p. 468). Similarly, faculty members involved in a study by Sahin and Thompson’s (2006) indicated that they needed “support, training, and knowledge about appropriate teaching pedagogies, improvement of school and classroom infrastructure, and time release from their teaching workload” (p. 85). The most successful programs were those which included appropriate training, on-site assistance, and adequate time and support for mentoring programs (Holahan, et al., 2000). These findings coincide with the findings of Frank et al. (2011), who concluded that “the effect of exploration and experimentation was statistically significant for teachers at intermediate levels of implementation” (p. 149). Together, findings from these studies indicate that when teachers perceive the innovation for which they have been trained as
advantageous to teaching and learning and also perceive that implementation is compatible with their skill set, they will be more likely to integrate it.

**Site-specific.** A reoccurring theme in technology professional development literature is that professional development activities should planned and delivered based on the specific needs of those in the school community (Bennison & Goos, 2010; Pan & Franklin, 2011; Uslu & Bumen, 2002). These researchers suggested that if teachers are provided with technology integration professional development that is aligned with their competence level and subject area, they are more likely to integrate the technology into their everyday practice. Uslu and Bumen (2002) found that technology integration significantly increased after participants completed the Intel Teach professional development program (p. 120); however, the increase “was retained for six weeks but technology integration did not increase after six weeks” (Uslu & Bumen, 2002, p. 122). Additionally, no significant difference was found in teachers attitudes towards technology in the Uslu and Bumen study. This shows that although the program did change practice temporarily, it was sustained for only a short time. The researchers attributed this regression to both a “lack of instructional support” (Uslu & Bumen, 2002, p. 122-123) and the “one size fits all” (p. 122-123) approach that often characterizes professional development programs developed outside the “organization context” of the individual school (p. 122-123). Based on these findings, the researchers advised professional development providers to "determine the teachers’ current technology integration stage and then to implement professional development programs which are aligned with teachers pre-existing knowledge” (Uslu & Bumen, 2002, p. 123). Researchers such as Uslu and Bumen (2012) stated that such an approach may increase the teachers’ “willingness to participate in PD [professional development] programs about TI [technology integration]” (Uslu & Bumen, 2002, p. 123). The case for site-
specific professional development is clearly stated in the preceding studies; however, professional development has not always concentrated on the specific needs of a community or its individual members (Darling-Hammond, 2005).

In the past, many professional development opportunities consisted of isolated workshops which concentrated on district-level or state-level initiatives and programs (Darling-Hammond, 2005). However, leading researchers in the education field such as Darling-Hammond did not see this in-service model as sufficient, and began to suggest that professional development be based on a “model in which teachers confront research and theory directly, are regularly engaged in evaluating their practice, and use their colleagues for mutual assistance” (Darling-Hammond, 1998, p. 11).

**Job-Embedded Professional Development**

The first informal teacher-initiated change process, job-embedded professional development (JEPD), relies on methods which are described as:

1. Experiential, engaging teachers in concrete tasks of teaching, assessment, and observation that illuminate the processes of learning and development;
2. Grounded in participants' questions, inquiry, and experimentation as well as profession-wide research;
3. Collaborative, involving a sharing of knowledge among educators;
4. Connected to and derived from teachers' work with their students as well as to examinations of subject matter and teaching methods;
5. Sustained and intensive, supported by modeling, coaching, and problem solving around specific problems of practice; and

Evident in this description of job-embedded professional development (JEPD) is the emphasis on providing site-specific, practical, teacher-facilitated opportunities for professional development. These opportunities take place during the workday (Croft, et al., 2010) and give teachers the opportunity to be active participants in their professional learning process (Hannafin
JEPD was explored through the professional development literature which emphasized that JEPD in schools should be site-specific, facilitated by in-house staff members, and utilize collegial relationships and collaboration among teachers to drive change.

**Site-specific.** No two schools are identical, despite similarities they may share in demography and in challenges confronted when implementing new programs to improve student learning (Penuel et al., 2013; Phelps & Graham, 2008). Penuel et al. (2013) found “strong evidence that local dynamics are key in shaping the course of any instructional practice or reform, policies set the stage for the innovations, and interactions with colleagues mediate the response to the innovation” (p. 23). The implication of the Penuel et al. (2013) study is that when local dynamics are positive and interactions with colleagues useful, innovations can be positively influenced by the individuals participating.

Conversely, because every school environment is unique, Phelps and Graham (2008) noted that there will always be some staff who remain resistant to an innovation or to ongoing professional learning and change (Phelps & Graham, 2008, p. 132). In the school Phelps and Graham (2008) studied, “problems arose, and in some cases were not overcome, where past practices and school culture had coloured staff attitudes and assumptions about professional learning” (Phelps & Graham, 2008, p. 128). Because of these challenges, the researchers asserted “the criticality of closely examining a school’s history and culture prior to implementing a technology professional development program” (Phelps & Graham, 2008, p. 128). In addition to being mindful of a school’s site-specific history and culture, Darling-Hammond and McLaughlin (1995) stated that there must be sustained and intensive coaching supported by modeling for JEPD to succeed. This coaching is often provided by in-house support staff members who are familiar with the needs and goals of an individual school.
**In-house technology staff.** A second factor identified as important to JEPD is in-house technology staff members who facilitate learning. Reinhart, Thomas, and Toriskie (2011) recommended that “school districts should consider the use of technology facilitators to support teachers in such schools with the necessary training and support” (p. 191). Broussard (2006) also found evidence that in-house professional development can be supported and facilitated by the inclusion of school-based technology facilitators. Compared with schools with no on-site technology facilitators, those with on-site facilitators showed significantly larger increases of technology proficiency among the teachers (Broussard, 2006). These results illustrated that on-site facilitators were able to support professional development practices based on the teachers’ needs, facilitated mentoring among teachers of different ability levels, scheduled JEPD opportunities, and provided teachers with ideas and tools for integration on an as-needed basis (Broussard, 2006). Broussard (2006) also indicated a need for further research concerning the skills of technology facilitators as well as the ways they interacted with teachers to help them integrate technology into their classrooms and curriculum. Similarly, the claim for more research concerning technology facilitators was reflected in a study by Reinhart et al. (2011) which occurred several years later. Beyond necessary staff support, Darling-Hammond and McLaughlin (1995) recommended that professional development be collaborative and involve sharing knowledge among educators, indicating a need for collaboration and support among colleagues.

**Collegial support and influence.** A third factor addressed in the JEPD literature is a need for the support and collaboration of one’s colleagues in the technology integration process. These collegial relationships are identified in several studies as important to technology integration (Frank, et al., 2004; Penuel, et al., 2013; Sahin & Thompson, 2006; Shapley et al.,
2006). Specifically identified in the literature as central to the change process were collaboration among teachers with similar experiences and the influence of social capital, or “the potential to access resources through social relations” (Frank, et al., 2004, p. 151).

Change facilitated through teacher collaboration was reflected in the area of educational technology in studies conducted by Sahin and Thompson (2006) and Shapley et al.(2006). Sahin and Thompson (2006) explored instructional computer use by college of education faculty. Faculty members indicated on a survey that they had “a great deal of collegial support” which was “influential in changing strong attitudes” (Sahin & Thompson, 2006, p. 89). Further evidence supporting the importance of collaboration to technology integration can be found in an evaluation study of technology immersion in Texas schools. Teachers involved in these technology immersion schools reported “more frequent collaborations [with colleagues] than control teachers” who were not faced with technology immersion (Shapley et al., 2006, p. 53). Because the school in the Shapley et al. (2006) study implemented a common new innovation, teachers relied on collegial support to learn and integrate technology in their classrooms. The importance of continued collaboration to sustain the change process was reported in a study by Frank et al. (2011). The researchers hypothesized that “the more a teacher at a high initial level of implementation accesses the knowledge of others, the greater the likelihood the level of implementation will be sustained” (Frank et al., 2011, p. 141-142). These researchers found the effect of interactions with others was “statistically significant for those at the highest initial levels of implementation” (Frank et al., 2011, p. 149).

Alongside collaboration with colleagues, those teachers who reached higher Stages of Concern and Levels of Use and were successful in technology integration were found to be integral to the change process because they were respected and influential at the school level
(Frank et al., 2004; Frank et al., 2011; Penuel et al., 2013; Sahin & Thompson, 2006). When Penuel, et al. (2013) examined the intricate system of change within a school, they suggested that teachers were more likely to utilize an innovation “if they are exposed to professional development and school colleagues whose practices are consistent with the external institution and who can provide a knowledge base on which they can draw” (Penuel et al., 2013, p. 22). Sahin and Thompson (2006) and Frank, Zhao, and Borman (2004) likewise found that when faced with technology integration, faculty members sought support from those colleagues who had previously adopted and were already using the specific innovation. Working with these colleagues had a positive impact on the decision to adopt the innovation. Furthermore, the individuals who provided help tended to “hold leadership roles in the social system” (Sahin et al., 2006, p. 90).

The findings of these studies are of interest because they show evidence of a potential link between professional development, communities of practice, and teacher leadership, especially when there is a need to move individuals towards higher Stages of Concern and Levels of Use (Hall & Hord, 2006). These latter stages are identified by Hall and Hord (2006) as SoC 5 Collaboration and SoC 6 Refocusing which parallel LoU V Integration and LoU VI Renewal. In these top stages, those who established implementation of an innovation partook in the ongoing process of evaluating and improving their use and execution of the innovation (Hall & Hord, 2006).

**Informal Communities of Practice**

A third informal teacher-initiated change process that facilitated technology integration was informal communities of practice. Communities of practice, also referred to as professional learning communities (PLCs), professional learning networks, and collaborative learning
environments, are described by Wenger (1998) as “groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly.” These communities can exist in any organization and occur within businesses, across business units, or even across company boundaries (Wenger, 1998). According to Wenger (1998), “because membership is based on participation rather than on official status, these communities are not bound by organizational affiliations; they can span institutional structures and hierarchies” (p. 3-4). While the concept of communities of practice emerged from the business world, Wenger (1998) found them in other organizations such as government, education, and civic life.

Communities of practice are defined by three dimensions: a joint enterprise, mutual engagement, and a shared repertoire (Wenger, 1998). In the present study, the technology plan gave teachers resources and the employment contract required them to implement technology. Formal professional development and informal JEPD gave the participants knowledge and a shared vision (Frank et al., 2011; Vanderlinde & van Braak, 2011). Therefore, teachers at the study school had already embarked on a joint enterprise. Existing collegial relationships supported increased collaboration and mutual engagement in practice (Frank et al., 2004; Penuel et al., 2013; Sahin & Thompson, 2006; Shapley et al., 2006). Collaboration established a base for a shared repertoire and for seeking constant improvement in implementation of the innovation.

The community of practice at the study school had the potential to move teachers to the Impact stages of the Stages of Concern described by Hall and Hord (2006) as SoC 5 Collaboration and SoC 6 Refocusing, stages which parallel LoU V Integration and LOU VI Renewal. Teachers who reached these higher stages and levels did so in part because of the collaborative work accomplished through the communities of practice. As a result, the
expansion of knowledge continued as teachers engaged in more sophisticated reflection on their practice (Hall & Hord, 2006).

Peter Senge examined learning organizations in his book, *The Fifth Discipline* (1990), and described “learning organizations” as “organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together” (Senge, 1990, p. 3). According to Senge, practice of the five disciplines was essential to the process of becoming a learning organization. The five disciplines are content masters, mental models, building shared vision, team learning, systems thinking, and personal mastery (Senge, 1990). These disciplines were described by Senge in more detail. The first discipline, content mastery, is the discipline of continually clarifying and deepening our personal vision, of focusing our energies, of developing patience, and of seeing reality objectively” (Senge, 1990, p. 7). The second, mental models, are “deeply ingrained assumptions, generalizations, or even pictures and images that influence how we understand the world and how we take action” (Senge, 1990, p. 8). The third discipline, building shared vision, is “the capacity to hold a share picture of the future we seek to create” (Senge, 1990 p. 9). The fourth discipline, team learning, refers to “the process of aligning and developing the capacities of a team to create the results its members truly desire” (Senge, 1990, p. 10). The fifth discipline, systems thinking, “integrates the others, fusing them into a coherent body of theory and practice,” according to Senge (p. 12). Wenger (1999) and Senge (1990) provided a theoretical explanation of a community of practice, which education research indicates is one of the most effective vehicles for providing professional development in schools (Kopcha, 2010; Kopcha, 2012; Thompson, Gregg, & Niska, 2011; Tschannen-Moran, 2009). This section examined what
communities of practice are and how they relate to professional development, technology integration, and leadership.

**Professional development.** Communities of practice as a medium for professional development and instructional improvement have been studied by researchers for some time. At the core of these studies is that mutual trust among members of the community (Tschannen-Moran, 2009) is prerequisite to “learn[ing] how to do it better” (Wenger, 1998, p. 1). Central to improving practice is participating in open discussions of one’s teaching, while trusting that responses from community members will be reflective and supportive (Tschannen-Moran, 2009, p. 226). When mutual trust is a norm of the community, teachers are willing to de-privatize their instructional practices and present the work products of their students as evidence that is openly critiqued (Tschannen-Moran, 2009, p. 226).

Bouchamma and Michaud (2010) included teaching supervisors in their study of communities of practice. Their research examined learning through communities of practice that were guided by Wenger’s (1998) framework of (a) meaning: learning by experience, (b) practice: learning by doing, (c) community: learning by belonging, and (d) identity: learning by nurturing (Bouchamma & Michaud, 2010, p. 406). Through analysis of their interviews with the participants, the researchers found that supervisors gained both theoretical and practical knowledge by sharing successful and unsuccessful experiences with others in the community. Sharing their experiences also made them more aware of the expectations for and best practices germane to their supervisory positions and allowed them to develop collegial relationships with the other members of their community (Bouchamma & Michaud, 2010).

In their mixed methods study, Thompson, Gregg, and Niska (2011) investigated communities of practice in the middle schools using Senge’s five disciplines. These researchers
investigated a possible relationship between communities of practice and student learning. Both the administrators and teachers who participated in the study commented about the positive influence on student learning that resulted from the communities of practice (Thompson, Gregg, & Niska, 2011). These studies show that communities of practice have become a well-known professional development strategy that can be beneficial for administrators, teachers, and students. Although these studies provide useful findings, they did not examine informal communities of practice for the purpose of technology integration which is the focus of the present study.

**Technology integration.** Communities of practice that are supported by technology and those which focus on technology integration are present in several recent studies. Some studies (Moore, 2008; Valaitis et al., 2010) have revealed an interest in providing support and professional development in the form of an online community among professionals entering the workforce in variety of professions. In their study of nurses participating in online communities of practice, Valaitis et al. (2010) found that online communities were valuable to nurses in specialized fields. These nurses found that the communities were a good place to share their experiences, validate their practices, and adapt best practices with others. Moore (2008) similarly suggested that online communities of practice could be a valuable tool for social work education. In addition, Strycker (2012) found evidence through conducting surveys of pre-service teachers that there was interest in participating in an online support community for the purpose of gaining knowledge and support for technology integration during their student teaching experiences.

Similar to the previous studies, a mixed methods case study conducted by Vavasseur and MacGregor (2008) explored the implementation of online communities of practice in a
professional development program focused on technology integration with middle school teachers and administrators. The teachers in the study participated in face-to-face training sessions and online discussions using a course management system and were grouped according to similar subjects to facilitate integration and collaboration. The researchers found evidence that online communities of practice benefited teachers through the opportunity to share ideas, make connections, and gain proficiency. Through the collaboration, teachers became more favorable concerning the value of technology in education because of the increased communication and support from other teachers in their community (Vavasseur & MacGregor, 2008).

Like the previously mentioned studies, Kopcha (2010) studied communities of practice as a means for teacher development as they integrated technology into their instruction. As a component of the study, Kopcha developed a model that included mentoring and communities of practice to support teacher development. His model begins with conducting a needs analysis, the results of which are the basis for the formation of vision and goals by the mentor. The vision and goals are used to direct participants through several stages of technology integration which culminates in a community of practice. These stages allow participants to evaluate, revise, and then regroup to identify needs that become the focus of further professional development. Although the groups originally relied on a mentor who possessed higher skills, participation was expected to change the faculty from an “expert-led” system (Kopcha, 2010, p. 184) to one which “employs faculty and other resources from the school site” (p. 184) and “trains teachers and faculty to become technology leaders” (p. 184).

To evaluate the results of the original study, Kopcha (2012) studied “teachers’ perceptions of... barriers as they transitioned from full-time mentoring to teacher-led
communities of practice over a two-year period” (Kopcha, 2012, p. 1118). Teacher surveys, interviews, and observations revealed mixed results regarding teacher mentoring, professional development, and communities of practice. Teachers indicated that their mentor was integral in promoting positive attitudes and improved use of technology; however, their participation in communities of practice was mostly focused on troubleshooting and sharing ideas (Kopcha, 2012). Participants had not yet begun to re-evaluate and revise their practice as the original model suggested (Kopcha, 2010). Kopcha (2012) concluded that “not all communities of practice can or will contribute to positive teacher outcomes when learning to integrate technology” and “the specific activities that occur as part of or even prior to establishing a community of practice may play a larger role in promoting changes in teacher attitudes and practices with technology” (p. 1119).

As a result of these mixed findings, Kopcha (2012) suggested that for a community of practice to become successful and for teachers to improve their instruction and openly discuss student outcomes, using “activities that align with the principles of effective professional development” are essential (Kopcha, 2012, p. 1119). These findings make a connection between communities of practice and professional development. If effective professional development, such as relevant, site-specific professional development (Bennison & Goos, 2010; Pan & Franklin, 2011; Uslu & Bumen, 2012) and sustained support of JEPD (Armstrong et al., 2005; Frank et al., 2011; Liao, 2005; Neo & Calvert, 2012), existed previously in a school, communities of practice are more likely to become effective in enabling teachers reach the higher Stages of Concern and Levels of Use. To attain the higher stages and levels described by Hall and Hord (2006), teachers necessarily make substantial instructional improvements using
the innovation. Therefore, combining formal and informal change processes have implications for school improvement.

**School improvement.** As teachers improve their knowledge and instructional skill as a result of participating in communities of practice, it is important to consider are the benefits students potentially receive. In their analysis of literature involving teacher agency in communities of practice, Riveros, Newton, and Burgess (2012) argued that communities of practice not only have the potential to enhance teacher and student learning, but also can be a vehicle for school improvement and educational reform. These researchers (Riveros et al., 2012) maintained both that “school improvement initiatives focused on peer collaboration, like professional learning communities, need to engage in deeper reflection about the nature of action and practices in school” (p. 211) and that “professional learning communities are not a goal in and of themselves, they are a means for school improvement” (p. 211).

Sigurðardóttir (2010) and Williams (2013) found evidence that teacher collaboration in communities of practice was not only beneficial, but also central, to student learning and school improvement. Sigurðardóttir studied communities of practice in three schools in Iceland. The quantitative data she collected indicated a “significant relationship between the schools’ level of effectiveness and their level of a professional learning community” (Sigurðardóttir, 2010, p. 405). Her study stressed the importance of interdependency among those participating in the communities of practice as “a necessary condition for collaborative learning” (Sigurðardóttir, 2010, p. 407). Additionally, Sigurðardóttir (2010) noted the importance of interdependency as vital to the community in which “student outcomes are central, and the whole work in school is influenced by shared values and vision that focus on student learning and an organized structure that aims at open and shared practices” (p. 407-408).
In an urban school district in Texas, Williams (2013) found “statistically significant differences in elementary, middle, and high school achievement on the TAKS [Texas Assessment of Knowledge and Skills] in reading after 3 years (2006-2010) of district-wide implementation of PLCs [professional learning communities]” (p. 34). Examination of teacher interview data revealed that the teachers perceived the communities of practice as beneficial to facilitating professional collaboration, data-driven decision making, effective instructional practices, and improvements in school culture. Williams concluded that the results of the study “provide strong support that collaboration through PLC’s [professional learning communities] is an important piece of the equation for continuous improvement” (p. 39). Both Sigurðardóttir, (2010) and Williams, (2013) recommended that policy makers and administrators encourage collaborative learning opportunities by establishing PLCs in schools.

**Leadership.** Because school improvement is a goal for many school administrators, the role of mentors and supervisors (Bouchamma and Michaud, 2010; Kopcha, 2010; Kopcha, 2012) and administrators (Brouwer, Brenkelmans, Nieuwenhuis, and Simons; 2011; Pancucci, 2008; Thompson, Gregg, and Niska, 2011) in supporting and facilitating communities of practice is addressed in the existing literature.

Administrators serve a vital role in the community of practice as a source of support and vision. To fulfill this role, Bouchamma and Michaud (2010) and Thompson, Gregg, and Niska, (2011) suggested that administrators both fully understand the concept of communities of practice and realize that they improve their own practice by learning the steps to take to enhance the success of the communities they support. Brouwer et al. (2011) agreed, noting that to increase teacher engagement in communities of practice and reap the benefits of that engagement, “school leaders need to support efforts to stimulate mutual engagement, joint
enterprise and particularly shared repertoire” (p. 361). The importance of administrative leaders providing support and participating as members in communities of practice was also reflected in the research of Pancucci (2008). Pancucci described the process of the implementing communities of practice in an elementary school. Her research found positive shifts towards improved technology integration among faculty members who worked together in communities of practice. She noted, “administrators need to move from an autocratic topdown leadership model to a flattened shared model where all team members engage in leadership activities” (Pancucci, 2008, p. 68). This model of shared leadership (Angelle, 2010) possesses the potential to transform the school community into one that more closely resembles a community of practice.

The studies reviewed imply that if school leaders and administrators foster communities of practice and all members engage in a joint enterprise and have a shared repertoire (Wenger, 1998), improvement in teacher instruction, student learning, and the school as a whole will result (Brouwer et al., 2011). Previously noted, Kopcha (2010) created a change model that anticipated a transition in leadership from an expert mentor to a member of the community or practice, a change that did not occur at the school Kopcha (2010, 2012) studied. Other research, for example, a study by Staples et al. (2005), found that teacher leadership was instrumental to the success of technology integration.

Informal Teacher Leadership

The final informal teacher-initiated change process identified by Brownfield (2008) was informal teacher leadership. The literature suggests that teacher leadership is an evolving topic in educational research (Silva, Gimbert, & Nolan, 2000; Pounder, 2006). Teachers take on leadership responsibilities in formal, official capacities, such as mentors, and in informal,
unofficial capacities, such as teachers who are consulted by others because of their expertise. For the purposes of this study, informal teacher leadership is of interest.

Staples et al. (2005) identified teacher leadership as one of the scaffolds that supported technology integration in their study at three urban elementary schools. Teachers emerged as informal leaders at these schools because they possessed technology expertise that principals often did not. To create a space for the informal teacher leaders to share their expertise, Staples et al. noted that formal structures and coaching were needed (p. 303-304). Informal teacher leaders who emerged in the present study were often digital bridges (Fryer, 2006) who assisted digital immigrants (Prensky, 2001) and who served as resources for on-site professional development. This section will examine what teacher leadership is, particularly informal teacher leadership.

**History of teacher leadership.** Silva et al. (2000) and Pounder (2006) noted that the history of teacher leadership occurred in waves. The first wave operated within the bureaucratic system, giving teachers leadership roles such as department heads, master teachers, and union representatives. The second wave concentrated on instructional leadership, giving teachers separate positions in areas such as curriculum development and staff development. However, the second wave placed teachers in a separate environment, away from other teachers. The third wave involved teachers taking on roles as a vital part of teachers’ everyday experience. They “collaborate with other teachers, discuss common problems, share approaches to various learning situations” and participate in problem solving and motivation (Silva et al., 2000, p. 781). Pounder (2006) synthesized third wave models of teacher leadership to suggest that the qualities possessed by these leaders could lead to a fourth wave of “transformational classroom leadership” (p. 542). According to Pounder (2006), transformational leaders inspire their
followers, bringing them to a new level at which they achieve and produce (p. 542). Change can be facilitated through this transformation through both formal teacher leaders and informal teacher leaders.

**Master/mentor teachers.** Much of the research involving teacher leadership involves teachers who are officially appointed to the positions of master teacher or mentor teacher. According to Mayo (2003) and Holahan et al. (2001), the master or mentor teacher leadership model refers to programs that provide teachers with specialized training for their subject area or specific program. These teachers then actively participate in training other members of their staff and are also active in decision-making at their school.

Mayo (2003) suggested that programs and certifications instituted in Texas for master reading and math teachers allowed teachers to become “scholar practitioners” (p. 32) who “exhibit peer leadership and support decisions with evidence from research data” (p. 32). Holahan et al. (2001) reported that using the mentor teacher model “allows for greater efficiency compared to traditional training approaches that do not use a mentorship or train the trainer model” (p. 338). In evaluating the Texas master teacher program, Holahan et al. (2000) found that through the training and process of mentoring, with few exceptions, the mentor teachers exhibited a high level of expertise in the field, used technology regularly, and showed a change in their teaching approaches

Wright and Wilson (2007) evaluated a master technology teacher program at the University of Alabama. This sustained professional development effort joined in-service teachers, pre-service teachers, and university faculty in efforts to integrate technology. Interviews conducted over a five year span showed that the participants in the program had an overall positive attitude towards the program. Teachers in the master technology program
became the “go-to technology person at their school... some serving as the tech leader” (Wright & Wilson, 2007, p. 85). These studies give support to the benefits of master/mentor teachers for professional development and for technology integration.

**Informal teacher leadership.** The aforementioned studies viewed teacher leadership in a non-administrative, but formal capacity. However, important to this study is teachers who become leaders in an informal capacity. Informal teacher leadership was described by (Angelle, 2010) as occurring when teachers participate in decision-making for a school. Teacher involvement in schoolwide decision-making is successful when faculty members and administrators share common goals for school excellence, consider the best interest of students, share a mutual trust, and possess strong, positive collegial relationships (Angelle & DeHart, 2011; Angelle & Teague, 2011; Angelle, et al., 2011).

Beyond these common goals and positive relationships, Angelle and DeHart (2011) identified teacher expertise as an important component of an informal teacher leader. In their study, the focus was a comparison of teachers’ perceptions of leadership at the elementary, middle, and high school levels. Results of a questionnaire administered for the study, indicated that elementary teachers rated sharing expertise, defined as “teachers willingness to offer me assistance if I have questions about how to teach a new topic or skill” (p. 149) and supra-practitioner, defined as “teachers willingly stay after school to work on school improvement activities” (p. 149), as important components of a teacher leader. Additionally, elementary school teachers rated these components of teacher leadership significantly higher than did middle and high school teachers. The Angelle and DeHart finding that elementary teachers showed high levels of respect for peers who shared their expertise is pertinent to the current study. Teachers at the school involved in this study exhibited leadership by voluntarily responding to requests for
assistance from their colleagues. As in the Angelle and DeHart study, these teachers were not officially appointed as mentors or master teachers.

In her study of a middle school, Angelle (2010) found that informal leadership opportunities gave teachers “who might not be deemed leaders in other school settings the opportunity to develop leadership skills” (p. 14). Moreover, because “leaders [were] nurtured” at the middle school, teachers wanted to lead, “giving rise to an organizational structure committed to valuing the expertise of the individual, rather than an assigned and formal title” (Angelle, 2010, p. 14). Two benefits Angelle attributed to teachers’ involvement as informal leaders were “increases [in] self-efficacy and…a greater desire to serve the organization” (p. 14).

The Angelle (2010) study indicated that when informal teacher leadership is fostered, teachers improve their practice. Additionally, Angelle et al., (2011) identified teacher leadership as a “variable that can contribute to the success of the organization through the relationship with collective efficacy as well as the school culture” (p. 18). This collective efficacy and shared leadership also had implications for teachers participating in communities of practice. Angelle and Teague (2011) studied two school districts that implemented communities of practice and found one district was more successful because all stakeholders had the same goal which was student learning (Angelle & Teague, 2011). The more successful district exhibited “shared vision, supportive structures, shared leadership, and decision making” (Angelle & Teague, 2011, p. 40). These studies connect teacher leadership to communities of practice, further connecting the three teacher-initiated change processes and providing a solid basis in literature for the current study.
Conclusion

The literature reviewed in this chapter provides a solid base for the topics addressed in this study. The theoretical framework was established through examination of Hall and Hord’s (1987) Concerns-Based Adoption Model. Next, literature related to the formal and informal change processes that facilitate innovation implementation was analyzed. These formal and informal change processes, formal professional development, informal JEPD, informal communities of practice, and informal teacher leadership, were scrutinized to find interconnections among them and to technology integration, as depicted in the Figure 1.1 model. While there was much evidence supporting the usefulness of formal and informal change processes to promote professional development for the purpose of technology integration, few studies undertook examination of interconnections among them or focused on informal development of the teacher-initiated change processes. This study contributes to the literature by exploring these issues. The methods used to collect data for this study are described in detail in Chapter 3.
CHAPTER 3: METHODOLOGY

This study investigated participants’ perceptions of formal change processes and informal teacher-initiated change processes that resulted in technology integration at a small, private elementary school located in a capital city in the southeastern United States. Also investigated in the study were teachers’ perceptions of the changes in teaching and learning that occurred due to technology integration in their classrooms. Chapter 3 describes the methods used to collect and analyze the data. The chapter is divided into six major sections, research design, sample, data collection procedures, instrumentation, data analysis, validation strategies, and finally a summary of the sections concludes the chapter. Important to note is that the researcher worked at the research site. Researcher bias is discussed in Chapter 1 on page nine.

Research Design

This longitudinal, descriptive case study (Yin, 2003) used a single-case, holistic design (Yin, 2003) to examine an intrinsic case (Creswell, 2007). Creswell (2007) described an intrinsic case as one “in which the focus is on the case itself…because the case presents an unusual or unique situation” (p. 74). The “unusual or unique situation” (Creswell, p. 74) at the case study school was the change process teachers developed that led to the success of technology integration and to the use of more engaging teaching methods.

The research design was based on the following recommendations offered by Yin (2003) and recounted by Baxter and Jack (2008):

(a) The focus of the study is to answer “how” and “why” questions; (b) you cannot manipulate the behavior of those involved in the study; (c) you want to cover contextual conditions because you believe they are relevant to the phenomenon under study; or (d) the boundaries are not clear between the phenomenon and context (Baxter & Jack, 2008, p. 545).
This study satisfies all four recommendations. First, interview data were collected using protocols that posed “how” and “why” questions to teacher participants to examine their perceptions of the formal and informal change processes that facilitated successful technology integration. In addition, these questions sought information pertaining to the changes in teaching in learning that occurred as a result of technology integration. Second, data collection occurred after the implementation of technology integration was underway. Thus, no attempt was made to manipulate the behavior of participants.

Third, the study was conducted within the bounded system (Creswell, 2007) of the school, a necessary condition for a case study. Therefore, the events that occurred were limited to that particular school and therefore, are unique to the context of that school. Moreover, in her study conducted at the school, Brownfield (2008) reported that the school context was instrumental to the establishment of collaborative relationships among teachers and that these relationships were relevant to the success of technology integration. Fourth, the phenomena of interest, the formal and informal change processes and the changes in teaching and learning that ensued from technology integration, cannot be separated from the operational and social context of the school. These phenomena were also unique to the school because the informal teacher-initiated change processes developed as a result of the expectations set forth in a technology plan that was reinforced by the principal. Hence, a case study design was appropriate for the study.

Additionally, a single, holistic design was chosen for this study because the context of this case was “in one environment because it is a unique or extreme situation” (Baxter & Jack, 2008, p. 549). The one environment was the school and the unique situation was the successful integration of technology driven by formal and informal change processes. Therefore, participants were chosen and the data analyzed to explain the case of interest.
Sample

Qualitative research involves purposeful sampling of the site and the participants involved in the study (Creswell, 2007, p. 125). For this study, convenience sampling (Creswell, 2007, p. 126) was used for both. The site was a small, private elementary school in the capital city of a southeastern state where the researcher worked, and therefore, there was a limited population of possible participants within the boundaries of the school. To select the teacher participants from among the faculty, two selection criteria were established. The first criterion was to select teachers who had taught at the school during the years that technology integration took place. Therefore, the teachers endured the same experiences when integrating technology into classroom teaching. The second criterion was to select from among teachers meeting the first criterion, those who taught in grades three, four, or five. These grade levels were chosen because they were structured similarly and encountered the same technology innovations during the course of the study. These innovations included interactive whiteboards in each classroom and a program that enabled each student to have a laptop computer at school every day. The sampling strategy and selection criteria yielded two third grade teachers, two fourth grade teachers, and two fifth grade teachers. In addition, the principal became a participant in the last round of data collection because the teacher participants credited her support as a driving factor in the success of technology integration. Her inclusion in the study also provided confirming and disconfirming data from an additional stakeholder perspective.

Teachers in the sample represented a range of technology proficiency, participant age, and years of experience. Teachers also represented the three types of digital learners discussed in Chapter 1; three teachers were digital immigrants (Prensky, 2001), one teacher was a digital
native (Prensky, 2001), and two teachers were digital bridges (Fryer, 2006). Participant information is presented in Table 3.2. All names in the table and elsewhere are pseudonyms.

As can be seen in the table, teachers varied greatly in age and experience. Regarding age, one teacher was in her twenties, one was in her forties, three were in their fifties, and one was in her sixties. Teachers’ years of experience spanned from less than five years to over thirty years. All six teachers had bachelor’s degrees, four of the six had master’s degrees in education, and one had a law degree. All teachers were certified for their respective positions. In addition to the study participants, several non-participants who worked at the school described by participants as crucial to technology integration at the school. Therefore, these individuals are also included in the table and described in the same way as the study participants.

Each teacher’s background information, educational background and experience, and digital learner category (Prensky, 2001; Fryer, 2006) are described in the table. Classification as a digital native, digital bridge, or digital immigrant (Prensky, 2001; Fryer, 2006) was based on their age, attitude towards technology, and technology proficiency at the beginning of technology integration during the 2006-2007 school year. In addition, in Chapter 4, participants were also placed on Hall and Hord’s (2006) Stages of Concern and Levels of Use. Based on interview data, estimates of these placements were made by the researcher, who was an insider. The researcher made these determinations of Stages of Concern and Levels of Use (Hall & Hord, 2006) after all data were collected. A brief description of each participant accompanies the table.

Sheryl Katz was a third grade language arts and social studies teacher who taught at the school for approximately twenty years. Classified as a digital bridge, she was a self-professed guinea pig for trying technology innovations in her classroom. She previously obtained a
<table>
<thead>
<tr>
<th>Participants’ Pseudonym</th>
<th>Grade Taught</th>
<th>Subjects Taught</th>
<th>Years of Teaching Experience</th>
<th>Education and Areas of Certification</th>
<th>Age and of Digital Learner Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheryl Katz</td>
<td>3rd Grade</td>
<td>Language Arts, Social Studies</td>
<td>20 years</td>
<td>BS Communications, Alternate certification in education, M.Ed. Gifted Education, Reading specialist, Computer Literacy</td>
<td>Mid 50’s, Digital Bridge</td>
</tr>
<tr>
<td>Maria Sullivan</td>
<td>3rd Grade</td>
<td>Math, Science</td>
<td>30 years</td>
<td>BS Elementary Education, M.Ed. reading, Reading specialist, Educational Administration</td>
<td>Mid 50’s, Digital Immigrant</td>
</tr>
<tr>
<td>Sally Eaton</td>
<td>4th Grade</td>
<td>Language Arts, Social Studies</td>
<td>5 years</td>
<td>BS Elementary Education, M.Ed. curriculum and instruction, Educational Administration</td>
<td>Late 20’s, Digital Native</td>
</tr>
<tr>
<td>Deanna Zachary</td>
<td>4th Grade</td>
<td>Math, Science</td>
<td>35 years</td>
<td>BS Elementary Education, M.Ed. reading specialist, Educational Administration</td>
<td>Early 60’s, Digital Immigrant</td>
</tr>
<tr>
<td>Kellie Jacobs</td>
<td>5th Grade</td>
<td>Language Arts, Social Studies</td>
<td>5 years</td>
<td>BA History, Law Degree, Alternate certification in education</td>
<td>Early 40’s, Digital Bridge</td>
</tr>
<tr>
<td>Leah Shelly</td>
<td>5th Grade</td>
<td>Math, Science</td>
<td>18 years</td>
<td>BS Elementary Education, Educational Administration</td>
<td>Early 50’s, Digital Immigrant</td>
</tr>
<tr>
<td>Cathy Lafontaine</td>
<td>Principal</td>
<td>None</td>
<td>40 years</td>
<td>BS Elementary Education, M.Ed. Educational Administration</td>
<td>Early 60’s, Digital Immigrant</td>
</tr>
<tr>
<td>Non-Participants’ Pseudonym</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kristin Parker</td>
<td>2nd Grade</td>
<td>Technology Resource Teacher, 2nd Grade Broadcast Studio</td>
<td>15 years</td>
<td>BS Elementary Education</td>
<td>Late 40’s, Digital Bridge</td>
</tr>
<tr>
<td>Rita Riley</td>
<td>Librarian</td>
<td>Library skills</td>
<td>10 years</td>
<td>M.L.S. Library Science, Alternate certification in education, M.A. Management, B.S. Education</td>
<td>Early 60’s, Digital Bridge</td>
</tr>
</tbody>
</table>
certification in computer literacy and was one of the first teachers in the school to have an interactive whiteboard in her classroom.

Maria Sullivan, the third grade math and science teacher, was classified as a digital immigrant. She often worked with her more proficient grade level colleague to integrate technology into her classroom. An experienced teacher, she taught for over thirty years, with over twenty of those years at this school. She also enjoyed sharing resources, such as interactive websites, with other teachers.

Deanna Zachary, a digital immigrant, was the fourth grade math and science teacher. With thirty-five years of teaching experience, more than twenty of them at this school, she first feared technology and questioned her ability to learn and integrate it into her classroom. Nevertheless, she saw the benefits technology brought to her students and utilized it often. She branched out to integrate more technology-centered activities in her teaching and collaborated with her fellow fourth grade teacher, Sally, to present at a national technology conference.

Sally Eaton taught fourth grade language arts and social studies. In her twenties, she was the only participant in the study classified as a digital native. She was comfortable using technology and not fearful of integrating it into her teaching. However, with less than five years of teaching experience, she struggled to improve her instructional methods and classroom management and to incorporate content into her technology-centered lessons. She began to implement a project-based learning unit early in the technology integration process and presented it at a national technology conference with her grade level partner, Deanna.

Fifth grade language arts and social studies teacher and former lawyer, Kellie Jacobs had five years of teaching experience, all of them at this school. Because educational technology courses were part of her recent alternative certification program, she was very comfortable with
technology and was classified as a digital bridge. She was often among the first to integrate new ideas, such as blogs and wikis, into her fifth grade class.

Veteran teacher Leah Shelly, had approximately eighteen years of teaching experience and taught fifth grade math and science. A digital immigrant, she was hesitant to use technology and it was a constant challenge for her to become accustomed to using it in her classroom. However, she did often utilize interactive websites and online science experiments in her classroom.

Principal Lafontaine was a digital immigrant. In her early sixties, she had over 40 years of teaching experience and over 20 years of experience as a principal. Less than ten of those 20 years were spent at this school. Having earned her master’s degree in educational administration, she was certified as a teacher and as a principal. Although her use of technology was not in the classroom, she was educated concerning current trends in technology, attended conferences and trainings, and recognized the benefits of technology for students.

Non-Participants

Two members of the staff who were not included in the study were described by participants during the interviews as being important to the technology integration process.

Kristin Allen, a digital bride, was a second grade teacher at the school and eventually became a technology resource teacher at the school. An experienced teacher in Kindergarten, First Grade, and Second Grade, her creativity, enthusiasm, and innovative use of technology in the classroom was recognized by both fellow teachers and the administration. In her role as technology recourse teachers, she shares her passion for technology by helping model lessons for fellow teachers and producing a daily broadcast for students.
Rita Riley was the school librarian who was also a member of the tech team at the school. With a background in management and in the military, she entered the field of education later in life. Although she was in her early sixties, she was a digital bridge and enjoyed learning about new technology innovations such as blogs and wikis and helping other teachers integrate these into their lessons. These teachers did not match the selection criteria, but were identified in the interview data as being relevant to technology integration.

**Data Collection Procedures**

Once participants were identified, data for this study were collected through interviews conducted at three points in time during the first six years of technology integration at the school. Specifically, teacher interviews were conducted in the spring of 2008, the spring of 2010, and the spring of 2011. The principal was interviewed in the fall of 2011.

**Timeline of Data Collection**

This longitudinal study spanned five school years, inclusive of 2007-2008 to 2011-2012. During that time frame, data were collected utilizing Longitudinal Qualitative Interviews (Hermanowicz, 2013). Longitudinal Qualitative Interviews (LQIs) are a series of interviews “conducted with the same people over a time period sufficient to allow for the collection of data on…conditions of change” (Hermanowicz, 2013, p. 190). The three occasions of data collection coincided with significant changes related to technology integration, constituting an “amount of time sufficient to examine relevant change from one point to another” (Hermanowicz, 2013, p. 196). The first round of interviews was conducted after the introduction of interactive whiteboards, the second round of interviews occurred after laptop computers were made available to every student in third through fifth grades, and the third round of interviews was conducted after project-based learning (PBL) was implemented as an instructional method.
Teachers used the change processes they developed to facilitate successful integration each time a new innovation was introduced. Table 3.2 shows a timeline of data collection and includes major events that occurred during the respective year, and the data collected at that point in the study.

<table>
<thead>
<tr>
<th>School Year</th>
<th>Events</th>
<th>Data Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006-2007 1st full year of implementation</td>
<td>Interactive Whiteboard implementation</td>
<td>None</td>
</tr>
<tr>
<td>2007-2008 2nd full year of implementation</td>
<td>Job-embedded professional development</td>
<td>1st round of teacher interviews</td>
</tr>
<tr>
<td>2008-2009 3rd year of implementation</td>
<td>Job-embedded professional development</td>
<td>None</td>
</tr>
<tr>
<td>2009-2010 4th year of implementation</td>
<td>Laptop computers required of each student in grades 3-5</td>
<td>2nd round of teacher interviews</td>
</tr>
<tr>
<td>2010-2011 5th year of implementation</td>
<td>Second year of the laptop use Project-based learning units implemented</td>
<td>3rd round of teacher interviews</td>
</tr>
<tr>
<td>2011-2012 6th year of implementation</td>
<td>Third year of laptop use Second year of Project-based learning units</td>
<td>Principal Interview</td>
</tr>
</tbody>
</table>

**Instrumentation**

Semi-structured interview protocols (Cohen et al., 2010; Newton, 2010) were used to guide the interviews each of which lasted approximately thirty minutes. Across the three data collection points, some items on the protocol remained the same while other items were changed to reflect changes in the technology then being used at the school. The purpose of the interviews was (a) to gain participant perspectives about the formal change process and the informal teacher-initiated change processes used to facilitate technology integration and (b) the views of participants about changes in teaching and learning that occurred due to technology integration. The interview protocols are found in Appendices B, C, D, and E.
Interview Description

Interviews were conducted with teachers in grades three, four, and five, three times over the course of the study. A single interview with the principal was conducted in the last year of the study after all teacher interviews were completed. During the previous rounds of data collection, teacher participants identified the support of the principal as an important factor in facilitating technology integration. The frequency with which such comments were made prompted the inclusion of the principal as a study participant. From a research perspective, interviewing the principal provided another data source. An important stakeholder whose perspective developed outside of the classroom, the principal could provide confirming or disconfirming data. Thus, the principal interview data contributed to the credibility of the study findings.

Interview Protocol

The following description of the interview protocols used in each round of data collection shows how protocol items changed relative to the then current circumstances at the school. Additional probing questions were asked when necessary.

2008 interview protocol. The first set of interviews was conducted in the spring of 2008, near the end of the second year of implementation. As described in Chapter 1, these data were collected for a prior study (Brownfield, 2008) and both formed the foundation for the present study and provided baseline data. Protocol items concentrated on teachers’ perceptions of their initial experiences integrating technology, specifically, interactive whiteboards, into their teaching. Teachers were asked to describe the methods they used to learn and improve their use of this technology. While teachers at all grade levels school participated in the Brownfield
study, data from only the third, fourth, and fifth grade teachers were reanalyzed for this study. Example items from the 2008 protocol are:

- What do you believe is the best way to successfully learn to utilize your interactive whiteboard?
- How comfortable do you feel with using the interactive whiteboard? and
- How do you feel the interactive whiteboard has affected student engagement in your classroom?

**2010 interview protocol.** The second set of interviews, conducted in the spring of 2010, concentrated on two issues, the ongoing development of participants’ skills using the interactive whiteboards during the third and fourth years of technology integration, that is, the 2008-2010 school years and their experiences integrating the student laptop computers in conjunction with the interactive whiteboards. Some items for interview protocol were derived from findings of the Brownfield (2008) study which indicated that teachers had established collaborative relationships enabling them to call upon one another, especially the digital bridges, for information and help when difficulties were encountered. Thus, for the second round of data collection, protocol items delved deeper into how the collaborative relationships formed and the nature of the assistance provided. Items also explored the kinds of technology assignments students were given, whether changes in student behavior were noted, and whether teaching methods changed as technology integration proceeded. Examples of the questions are:

- Describe how you have progressed in integrating technology into the classroom in the past 4 years?
- How would you describe the support system and community within your school environment? and
• Describe how you work with your fellow teachers to integrate technology into your classroom?

2011 interview protocol. The third set of interviews, conducted in the spring of 2011, concentrated on teachers’ proficiency using the technology and the introduction of project-based learning at the school. Questions asked teachers to reflect on their experience with technology integration, to trace the development of their technology skills, and to describe the kinds of project-based units they were implementing in their classrooms. Example items include:

• When you compare your teaching strategies now with the strategies you used six or seven years ago before we got the interactive whiteboards, how would you say they have changed?

• Can you describe how your classroom learning environment has changed because of your use of the technology we have now?

• How much do you think teachers collaborate in developing PBL [project-based learning] projects [that integrate technology]?

Principal interview protocol. The principal interview was conducted in the fall of 2011 to obtain confirming and disconfirming data regarding data from teacher interviews and to further explore teachers’ assertions that the principal was instrumental to the success of technology integration. Some examples of questions are:

• I am curious about some of the driving forces that helped you make decisions about buying technology for classrooms. What would you say had the most influence on your decision to purchase other technology, such as the laptops?

• How do you feel the school has changed in the last five years since we began using the interactive whiteboards?
- Where did the idea of using PBL [project-based learning] come from? and
- What influenced your decision to implement PBL [project-based learning]?

Data Analysis

All interviews were digitally recorded and transcribed by the researcher. Using the procedure suggested by Bogdan and Biklin (1998), the transcript data were organized chronologically and read several times. To analyze the data, the constant comparative method described by Glaser and Strauss (1967) and Lincoln and Guba (1985) was used. Using this analytic procedure, the “researcher simultaneously codes and analyses data in order to develop concepts; by continually comparing specific incidents in the data, the researcher refines these concepts, identifies their properties, explores their relationships to one another, and integrates them into a coherent explanatory model” (Taylor & Bogdan, 1984, p. 126).

To analyze the data, a list of a priori codes (Creswell, 2007) was developed using the Brownfield (2008) study and the related literature. Likewise, two a priori themes, change processes and changes in teaching and learning resulting from technology integration, were based on the Brownfield (2008) study. Codes related to the a priori themes and emergent codes surfaced during the coding process and can be found listed in Appendix F. The qualitative data software program, ATLAS.ti, was used to organize the information. All codes were analyzed and categories were developed. These categories were then compared and combined into common themes, including emergent themes (Creswell, 2007, p. 152-153) and the two a priori themes. A list of these themes and the related a priori or emergent codes can be found in Appendix G.
**Validation Procedures**

Several validation techniques, described by Creswell (2007), were employed in this study. One of the validation strategies Creswell recommended was prolonged engagement and observation in the field. Because the study took place over a five year time span, there was prolonged engagement with the participants in the environment being studied. Also, as part of the prolonged engagement, the researcher “work[ed] with people day in and day out, for long periods of time” (Fetterman, 1998, p. 46, in Creswell, 2007).

Another validation strategy Creswell recommended was the use of rich, thick descriptions to illustrate details of the setting and participants and to present the findings. Therefore, detailed descriptions of the setting, interviews, and participants were provided in the study. Data triangulation (Creswell, 2007), a third validation strategy Creswell discussed, provided corroborating evidence. The perspectives of multiple interview participants at the school provided data triangulation in this study. Specifically, teachers at multiple grade levels and the principal provided viewpoints from different stakeholders that were compared and contrasted for confirming and disconfirming evidence. In addition, three cycles of interviews were conducted with the teacher participants over the course of the study. Finally, as Creswell (2007) suggested, during and after each interview, member checking was utilized to clarify and confirm participants’ responses to interview questions.

**Summary**

The methods used to conduct the study were discussed in this chapter in six major sections. The first section, research design, described the kind of study that was conducted and the conditions under which the research took place. Next, in the sample section, an explanation of the sample selection procedures was presented and descriptions of the participants were
shared. Third, data collection procedures presented a timeline for the study, explaining when data were collected during the course of research. The instrumentation section provided a discussion of the four different interview protocols used for the study. The fifth section, data analysis, was an account of how the interview data were analyzed. Finally, the validation strategies used in this study were shared. Based on these methods, the case study was developed. The findings of the analysis are presented in detail in Chapter 4 and discussed in Chapter 5.
CHAPTER 4: FINDINGS

This descriptive case study (Yin, 2003) involved the intrinsic case of a small, private elementary school located in the capital city of a southeastern state. Interviews were conducted with teachers and the principal to explore their perceptions of both the change process used to implement an instructional innovation, specifically technology integration, and the effects of the innovation on teaching methods and student learning. Unique about the change process that unfolded was that teachers initiated several informal change processes which were essential to the successful implementation of the innovation. These informal teacher-initiated change processes built on formal change processes, such as professional development provided by experts, which laid the foundation for technology integration. In combination, the formal change processes and informal change processes led not only to the integration of technology at the school, but also to substantial changes in instruction.

In this chapter, the findings are organized into the following sections suggested by Yin (2003). First, because “setting is particularly important” (Creswell, 2007, p. 163) in case study research, a detailed description provides background information about the school. Next, the findings of the constant comparative analysis are presented. In addition to the two a priori themes (Glaser & Strauss, 1967), change processes and changes in teaching and learning, three emergent themes were found: administrative support, student contributions, and time challenges. The findings are presented and interpreted through the conceptual framework of the CBAM model, particularly the Stages of Concern and Levels of Use (Hall & Hord, 2006). Important to note is that estimates of teachers’ placement on the Stages of Concern and Levels of Use (Hall & Hord, 2006) were made by the researcher, who is an insider, based on interview data. The estimates were made after the conclusion of data collection. Finally, a summary concludes the chapter.
Background

Setting

The site for this study was a small, private elementary school. Founded in 1948, the school spans a city block in the downtown area of a capital city, just blocks from the state capitol building. As you enter the red brick buildings which stem from the 165-year-old church, you do not expect to view a model of modernity within its classrooms. However, as you begin to traverse its halls, there is much evidence of a high-tech learning environment complete with an interactive whiteboard in every classroom, plentiful classroom computers, laptop computers for each student in grades three, four and five, classroom response systems, an up-to-date computer lab, and a working broadcast studio.

Prior to the 2006-2007 school year, a similar tour of the school would have been a very different experience. The existing technology was meager, teachers had limited access to the equipment, and there were few personnel available to assist with using the equipment. In her 2011 interview, Principal Lafontaine, explained, “When I first came here, there were very few computers and most of them were old and had not been updated. [Previously,] I had been in a public school that had Title II money and we had done more.” The two third grade teachers who participated in the study agreed. Language arts teacher, Sheryl, who was in her mid-fifties, remembered that students used computers primarily for assignments such as the accelerated reader program. In her view, the computers were “more of an accessory and an enrichment” than a tool for everyday teaching and learning.

Relegating the classroom computers to the status of “an accessory” might seem dismissive, but the description was both accurate and reasonable under the circumstances. Maria, the third grade math and science teacher who was also in her mid-fifties, emphasized that
“we only had four computers with forty children.” With so few classroom computers, integrating them into instruction was nearly impossible. Moreover, the amount of time students experienced waiting for their turn to use the computers made integration impractical.

In addition to the four computers per classroom, the school owned two interactive whiteboards. “There was one in the science lab, and we had the portable one that traveled back and forth between our rooms,” third grade language arts and social studies teacher Sheryl said. The time it took to retrieve the whiteboard from another classroom and set it up for use made integrating this equipment into instruction on a regular basis impractical as well. The access to technology described by Sheryl and Maria was replicated at the fourth and fifth grade levels; thus, teachers were severely hampered in using technology for teaching and learning purposes.

**The Technology Plan**

In the mid-2000s, the dearth of technology available for student learning prompted the principal and the school governing board to act. Principal Lafontaine related how events transpired:

> We started investigating things that we wanted to do and the teachers wanted to do. We had a committee form from the school board and a committee of the teachers. One night at the board meeting, one of the board members said, “If we were able to raise enough money to do anything we wanted, what would we do?” So we took a month to formulate an idea of what we wanted and presented it to the board. The board began a capital campaign for us to get started with the interactive whiteboards, the laptops for the teachers, computers for the students, updated software, and the personnel.

Input from the teachers, staff, and board members was incorporated into a carefully crafted, extensive technology plan which the governing board approved and funded in the spring of 2006.

The technology plan contained four components. The first component addressed technology needs at the classroom level. Each classroom was equipped with an interactive whiteboard and updated computers and software. Also, classroom response systems were added.
to all first through fifth grade classrooms. The second plan component focused at the school level, updating and expanding the computer lab, installing a broadcast studio, and hiring an additional staff member with expertise in technology to support teachers in implementing the plan.

The third component of the technology plan was a comprehensive professional development program for teachers, the costs of which were borne by the board. The first training occurred during the Summer Institute in 2006 to prepare teachers to integrate technology into their instruction at the start of the 2006-2007 school year. Subsequent training took place in teachers’ classrooms and at locations external to the school. Finally, the fourth plan component was included to maximize the prospect that the technology would be used as envisioned in the technology plan. This component changed the wording of the teachers’ annual employment contracts to stipulate that by signing the new contract, the teacher committed to attend the 2006 Summer Institute and to integrate the newly acquired technology into instruction on a daily basis beginning when the new school year started in August. Many teachers signed the new contract, but a few did not and left the school.

The components of the technology plan and the investment in equipment and software assured that teaching and learning at the school would not be the same. Within a few years, technology became an integral part of instruction in every classroom. However, as occurs with the introduction of most innovations, initial reactions included concerns about implementation (Hall & Hord, 2006).

**Initial Reactions: The 2006-2007 School Year**

Technology proficiency among teachers at the school varied widely and included many teachers who were digital immigrants, a few who were digital natives (Prensky, 2001), and a few
who were digital bridges (Fryer, 2006). Although the digital bridges tended to be older, they were knowledgeable in the use of instructional technology and confident in learning to use new hardware and software. Regarding the professional development that took place at the 2006 Summer Institute and the expectations for classroom implementation that fall, Principal Lafontaine remembered that there were teachers on “both sides of the spectrum. We had some who were very techy, who were on the cutting edge and were very excited. We also had teachers who had meltdowns.” Teachers shared similar memories, describing reactions that ranged from fear, to interest, to excitement.

Deanna Zachary, a fourth grade teacher who was over sixty years old, was among the teachers who experienced fear. When she signed her employment contract, she knew that in three short months the new school year would start and she would be expected to teach using the interactive whiteboard. A digital immigrant, she discussed her initial feelings, saying

I wanted to quit! Being out of school as long as I’ve been, I was very apprehensive about it, even afraid of it. It was just like when they gave us our first computers, I was afraid I was going to break it and real nervous about using it. It was so much to think about at one time, so the initial burden seemed to be overwhelming.

Deanna’s words helped to locate her on Hall and Hord’s (2006) Stages of Concern (SoC). Her most intense concerns at this point were SoC 2 Personal concerns. She seemed to grapple with a sense of inadequacy about using the interactive whiteboard and may have worried about how much of her own time she would need to devote to developing a reasonable degree of competence with the technology. As an experienced teacher with established class routines, she may also have worried about how to manage the technology without losing the efficiency with which her class usually her operated. Such thoughts indicated that SoC 3 Management concerns were also intense for her, though they were somewhat less strong.
On the other end of the spectrum Principal Lafontaine mentioned, the more technologically confident digital bridges had a positive outlook. Third grade teacher Sheryl, who was classified as a digital bridge, was excited about the new innovation, but she also acknowledged that implementation would be challenging:

I loved it. I thought it was a great idea, but it was very difficult. We were trained on it several times at school and I went to a training off campus…. I think we were still in a little awe of it, but that summer we worked so hard and then using it every day and having the [teacher] laptop -- it all came together. I thought at first it was geared towards math and science and had to find things to do in English and language arts…. At that time, we were not very adept at searching and we would type in elementary language arts programs and only two or three games would pull up, as compared to the maybe thirty or forty in math and science.

Sheryl’s statement emphasized that she had overcome personal fears of inadequacy and her focus was on finding appropriate lesson materials for the interactive whiteboard. This focus on processes and tasks indicated that she began the change process at SoC 3 Management (Hall & Hord, 2006). She focused on the best way to use information and resources to support the innovation and find resources appropriate for her classroom. The remaining participants varied in their individual Stages of Concern and Levels of Use at the beginning of this study.

Findings

Central to the study were formal change processes and informal teacher-initiated change processes that led to successful implementation of technology integration. Although formal professional development was supported by the principal and school governing board, unique to the school were the informal teacher-initiated change processes that sustained technology integration over the course of the study period. The findings of this study included two a priori themes, change processes and changes in teaching and learning. In addition, there were three emergent themes, including administrative support, student contributions, and time challenges. These themes are discussed below.
Change Processes

The change processes at the study school included a formal process, specifically formal professional development, and teacher-initiated change process, specifically informal job-embedded professional development, informal communities of practice, and informal teacher leadership. Each change process is described by its foundation in literature, results of interview findings over time, and its role in technology integration.

Formal Professional Development

A major component of the school governing board technology plan was to provide professional development to build the knowledge and skills necessary for technology integration. Professional development is crucial for successful implementation of an innovation (Frank et al., 2011; Karmeshu et al., 2012), particularly when it is based on the identified needs of the specific school (Bennison & Goos, 2010; Pan & Franklin, 2011; Uslu & Bumen, 2002). Professional development can be considered a component of LoU I Orientation during which users “acquir[e] information about the innovation” (Hall & Hord, 2006, p. 160) and of LoU II Preparation during which users are “preparing for first use of the innovation” (Hall & Hord, 2006, p. 160). Activity at these two Levels of Use enable non-users of an innovation to gain the necessary knowledge and skills to move to the User category. By attending the professional development offered through the 2006 Summer Institute, the participants gained the fundamental skills needed to use the new technology. They described two kinds of formal professional development which are identified in Figure 4.1.

The figure indicates the two types of formal professional development that took place at the school. Formal professional development activities were the 2006 Summer Institute at the
school and subsequent workshops, which occurred throughout the span of the study. These formal strategies were supported by the school principal.

![Diagram](image.png)

**Figure 4.1.** Formal professional development change processes.

**2006 summer institute.** All teachers, including the six participating teachers, as well as the principal and the librarian, learned how to use the various technology tools provided by the technology plan during the 2006 Summer Institute. Three of the six teachers interviewed in 2008 and the principal, who was interviewed in 2011, commented on the Summer Institute. Third grade teacher Sheryl described the Summer Institute as the starting point for teachers to gain knowledge about the tools they were expected to begin using in their classrooms. According to Sheryl,

> There was the Summer Institute where we were taught about the new equipment and programs…. We all had to come in during different weeks in the summer and we worked so hard. There was a white notebook where we had to sign off that we learned to use the camera, interactive whiteboards, [teacher] laptops, etc.

Fourth grade teacher Deanna agreed that teachers “had a lot of workshops to get started.” During the training that summer, Deanna, a digital immigrant (Prensky, 2001), was overwhelmed by the technology tools she was expected to use daily in her classroom. Thinking back,
however, she realized that the Summer Institute was helpful because “the sessions we had at the school …really applied to our school.” These statements indicated that some teachers found the Summer Institute was effective because it was based on the school’s specific tools and needs.

**Subsequent technology training workshops.** As noted previously, professional development began soon after the technology plan was adopted by the school governing board and occurred both on campus and off campus. For example, Principal Lafontaine mentioned during her interview in 2011 that “some of us had gone to a presentation in the local school district” to learn more about the interactive whiteboards. However, these opportunities were not viewed as vital to the integration process. According to Deanna, who was one of four teachers to attend off-campus workshops, “when you go off campus and come back, you don’t really remember how to use it.”

On the other hand, five of the participants reported that the on-campus professional development opportunities were helpful, particularly when external trainers came into their classrooms and provided training during the school day. Sheryl remembered that an external trainer from the interactive whiteboard company came to the school several times to train her and the other third grade teacher in using the interactive whiteboard during class time with students present. She commented that

> it wasn’t until we got the interactive whiteboards in our rooms that we got comfortable with them. The man [an outside consultant] came in and we had the thirty children in the classroom on the carpet and he trained all of us. They wanted the children to interact with it as much as they could, so that’s what we did.

Similarly, in May 2010, during the first year of the student laptop program, an external consultant was brought into the school to assist teachers with laptop integration. Four of the six teacher participants recalled attending this training, including fourth grade teacher Sally. Sally found this training particularly useful because the consultant
gave us good, practical things that [students] can do work with each other or on their own. Stuff like using Google docs and websites [collaborative online tools that allow for several people to edit a text at one time] for student collaboration, playing with fonts and colors [to identify individual work within the group] and not just using words on the screen. These were more interactive than just typing, so [the students] could concentrate a little bit more on creative aspects.

Given the differences in familiarity with and proficiency in using technology described above, it is not surprising that in 2008 teachers differed in their stage of concern and level of use. Table 4.1 indicates that concerns ranged from SoC 2 Personal to SoC 5 Collaboration with most participants at SoC 3 Management (Hall & Hord, 2006). Digital bridges Sheryl and Kellie expressed concerns at SoC 4 Consequence, concerns which they addressed by making changes in the ways they and their students used the technology. Having the confidence and proficiency to make such changes located them at LoU IVB Refinement. The other teachers were at LoU III Mechanical Use and LoU IVA Routine (Hall & Hord, 2006), levels that are expected in the second year of implementing an innovation as complex as technology integration. There were no teachers still at SoC 0 Awareness, SoC 1 Information, LoU 0 Nonuse, LoU I Orientation, and LoU II Preparation during this round of data collection, so these were are not included in the table.

The Summer Institute and subsequent training were helpful, according to the teachers, but by 2008, they had begun to develop their own informal, collaborative approaches to professional development which gave rise to both teacher-initiated job-embedded professional development and communities of practice. These site-specific kinds of professional development emerged at the school that helped teachers reach the task and impact Stages of Concern and Levels of Use. The resulting changes for all rounds of data collection are summarized in a second table which follows the discussion of JEPD, Communities of Practice, and changes in teaching in learning as emphasis on these factors were instrumental to the changes.
<table>
<thead>
<tr>
<th>Stage</th>
<th>Stage Description&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Teacher Concerns</th>
<th>2008&lt;sup&gt;a&lt;/sup&gt; Interactive Whiteboards</th>
<th>Level</th>
<th>Level Description&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Teacher Actions</th>
<th>2008&lt;sup&gt;a&lt;/sup&gt; Interactive Whiteboards</th>
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</thead>
<tbody>
<tr>
<td>6: Refocusing</td>
<td>Exploring... major changes or... a more powerful alternative</td>
<td>Suggesting new ways to integrate technology to the principal</td>
<td>VI: Renewal</td>
<td>Re-evaluates the quality of use of the [technology]; seeks major modifications...or alternatives</td>
<td>Expands use of technology such as student laptop computers and PBL Opens Classrooms</td>
<td>Suggesting new ways to integrate technology to the principal</td>
<td></td>
</tr>
<tr>
<td>5: Collaboration</td>
<td>Focus[es]... on... cooperation with others</td>
<td>Sharing ideas, resources, and websites</td>
<td>V: Integration</td>
<td>Combines own efforts... with related activities of colleagues</td>
<td>Collaborating on instructional/PBL units</td>
<td>Suggesting new ways to integrate technology to the principal</td>
<td></td>
</tr>
<tr>
<td>4: Consequence</td>
<td>Focuses on impact; evaluating changes needed to increase...outcomes</td>
<td>Exerting teacher leadership; observing peers; trying new ideas</td>
<td>IVB: Refinement</td>
<td>Varies the use of the innovation to increase the impact</td>
<td>Participates in Communities of Practice</td>
<td>Suggesting new ways to integrate technology to the principal</td>
<td></td>
</tr>
<tr>
<td>3: Management</td>
<td>Focuse[s] on... processes and tasks... and time demands</td>
<td>Seeking in-house tech support; attending professional development; worrying about time commitment</td>
<td>IVA: Routine</td>
<td>Use of the innovation is stabilized; little thought... given to... consequences</td>
<td>In-house tech support</td>
<td>Suggesting new ways to integrate technology to the principal</td>
<td></td>
</tr>
<tr>
<td>2. Personal</td>
<td>Uncertain about... demands of the innovation [&amp;]... her inadequacy to meet those demands</td>
<td>Attended Summer Institute but feels inadequate</td>
<td>III: Mechanical Use</td>
<td>Focuses on short term, day-to-day use; attempts to master the tasks required to use the [technology]</td>
<td>In-house tech support</td>
<td>Suggesting new ways to integrate technology to the principal</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Quoted from Hall and Hord (2006, p. 140)

<sup>b</sup>Quoted from Hall and Hord (2006, p. 160)

<sup>c</sup>SoC 0 Awareness, SoC 1 Information, LoU 0 Nonuse, LoU I Orientation, and LoU II Preparation are not included in the table as they are non-applicable to teachers in this study.

<sup>d</sup>In 2008 implementation had been underway for two years.
Informal Job-Embedded Professional Development (JEPD)

The short-comings of formal types of professional development and the frequent need for immediate assistance led teachers to seek help from their colleagues. Teachers often noted that informal JEPD opportunities were helpful in implementing technology innovations such as interactive whiteboards and student laptop computers. This coincides with researchers (Croft et al., 2010; Darling-Hammond & McLaughlin, 1995; Hannafin & Hill, 2007) who stated that site-specific, practical, teacher-facilitated opportunities for professional development were an important aspect of successful change processes. JEPD opportunities identified by the teacher participants included access to in-house technology staff and collaboration with peers.

The in-house technology support staff, occasionally presented formal professional development workshops; however, the participants discussed these staff more often in the context of the informal assistance they provided, hence the placement of the technology support staff under JEPD. Informal JEPD also included collaboration among teachers. Although Principal Lafontaine suggested to teachers that they collaborate, an important finding of this study is that the participants sustained these collaborative efforts themselves, a finding discussed in greater detail below. As technology integration progressed from implementation to institutionalization (Hall & Hord, 1987), professional development changed from external providers to school-based sources, the in-house technology support staff and collaboration among teachers. The two types of informal JEPD are identified in Figure 4.2 and discussed below.

In-house technology support staff. Broussard (2006) found evidence that professional development can be effectively facilitated by in-house technology support staff, a finding also identified in the present study. The technology support staff provided on-site, and often in-class,
support when teachers faced challenges learning to integrate technology. For example, the IT (information technology) director could fix malfunctioning equipment and the technology facilitator could team teach and offer lesson suggestions to teachers. According to Principal Lafontaine, providing technology support staff that would be readily available to assist teachers was a priority of the technology plan.

We knew we had some support already built in to the faculty… people [tech team, librarian, technology facilitator, technology resource teacher][who could]… support and repeat [or reteach something and] not just [expect teachers to] learn it once [with no follow-up]. [Adding to] the personnel [we already had] seemed to be the logical next step. [We worked to get] people [who] were there for all levels of support [technical help, instructional support]…. As time went on, we did some personnel shifting [formalizing the tech team, bringing second grade teacher Kristin on as technology resource teacher] and put some into formal positions [technology facilitator, technology resource teacher].

In 2006, the technology support staff consisted of a variety of people including an information technology (IT) director to address and fix issues with technology equipment such as the interactive whiteboards, student computers, and teacher laptop computers, and myself, who served as both the technology facilitator and the technology instructor in the computer lab for students. As time went on and the amount of technology equipment and lessons involving
technology increased, additional daily support was needed to ensure equipment was functional and teachers prepared to integrate technology. To provide the additional support for teachers, in 2009, two people were reassigned to technology support staff positions. One, Kristin Allen, a second grade classroom teacher, became a technology resource teacher who worked with students in the school’s broadcast studio and was available for instructional support for teachers. The other person was the school librarian, Rita Riley. Although Rita remained the librarian, she was also assigned to collaborate as a member of the technology support staff to provide additional instructional support and help teachers develop technology related units. Collectively, these staff became known as the tech team.

In the 2008 interviews, teachers reflected that during the 2006-2007 school year, the first year of implementation, the teachers considered the technology staff members helpful in providing the support to help them apply their knowledge in their classrooms. Reflecting on the first year of technology integration, a third grade teacher Sheryl acknowledged that she appreciated “having tech people on-duty all the time to get over the first couple of weeks.” Availability of the tech team at this time set a precedent for both technical and instructional support so teachers could work through problems and challenges to successfully integrate technology. In a later interview in 2010, Sheryl shared her perception that the tech team was a central source of ongoing support for the teachers, commenting that

I think it's wonderful, I really do! You ask for help and you're overwhelmed with the people who want to help you... There's not a problem in the world they [the tech team] can't solve. You ask them something, they will have it for you the next day. If we need something, they arrange it or set it up…. All I can say about the tech team is that they make the teachers look really good. They make us [the teachers] shine and look smarter than we are. They make it look easier than it is, they really do. I think that’s a sign we have a good support staff because they're putting us first and making us look really good.
All six of the teacher participants were in agreement with Sheryl’s statement and mentioned receiving help from the tech team in a variety of ways including team teaching, modeling lessons, individual lessons, and help in creating instructional units. For example, three of the five teachers, fifth grade teachers Kellie and Leah and third grade teacher Sheryl, mentioned working with Rita, the librarian, to “set up a wiki.” These wikis were collaborative webpages used for instructional units. Two of the teachers Maria and Sheryl, remembered that technology resource teacher Kristin would model lessons using technology during class time, showing teachers how to do something. For example, third grade teacher Maria recounted that Kristin would “actually come in and teach classes or show us how to do something [model a lesson] with the interactive whiteboard.” Furthermore, three of the teachers, both third grade teachers and fourth grade teacher Deanna, referenced gaining new ideas for technology instruction from myself, the technology facilitator, when they were present during student computer classes which took place in the students’ classrooms. Deanna recounted, “You have been helpful, especially during the student’s computer classes. You have helped me bring other ideas into the classroom.” Because of these frequent interactions with tech team members, all six of the teachers were comfortable calling upon the tech team when support was needed, which is exemplified in fifth grade teacher Kellie’s comment that

\[\text{We have lots of support from the tech team if we choose to take it. I find it’s really good that you and Rita both can set up a wiki for me. If I can't figure out something then someone is available to do it or show me how to do it. Then as far as of the laptops with troubleshooting, the IT guy can usually fix those.}\]

Based on the teachers’ reactions concerning the tech team, the staff was a factor in facilitating change throughout the school and can be identified as one of the strategies that facilitated JEPD and technology integration throughout the school. Teachers often utilized available tech team members during the school day to help design and improve lessons. The
appreciation and need for in-house support from the tech team indicated that teachers were focused on day-to-day use of technology, consistent with the SoC 3 Management and LoU III Mechanical Use (Hall & Hord, 2006), which focus on tasks associated with an innovation. In addition, the interest expressed in gaining new ideas indicates that teachers’ use of technology was no longer a significant challenge and was becoming stabilized, a characteristic of LoU IVA Routine.

**Teacher collaboration.** As teachers continued to move up the Stages of Concern and Levels of Use (Hall & Hord, 2006) in integrating technology, a second kind of informal JEPD began to arise. Teachers began collaborating to better use the technology equipment and design lessons to achieve greater technology integration. The collegial relationships that were identified by several researchers (Frank et al., 2004; Penuel et al., 2013; Sahin & Thompson, 2006; Shapley et al., 2006) as an important factor in technology integration were also present in the relationships among teachers at the school. These relationships drove teacher collaboration which resulted in JEPD among teachers.

In the first round of data collection in 2008, all six of the teacher participants indicated that collaboration occurred with their partner teacher in the same grade level as they learned about and then began to use the new technology equipment. At each grade level, third, fourth, and fifth, by happenstance, one teacher had greater knowledge and competency in technology than the other and was able to offer help. Reflecting on her early efforts in integrating technology, Maria, a third grade teacher and a digital immigrant, recalled “the one that I share the most with is my coworker Sheryl [a digital bridge] because she has really gotten into it more. If I have any questions, I can go to her for that.” Although both Maria and Sheryl were experienced teachers, Sheryl agreed that she was more competent with technology than Maria,
but she also explained that collaborating with Maria enabled both of them to integrate technology more effectively, explore different learning techniques, and develop cross–curricular projects.

She explained that

We started with, “I’ll teach her one thing and she’ll teach me one thing.” Or, if she had an idea, I would suggest “maybe you could do this ….” Maria is the type that would go through everything and I was the type that would download the whole two hundred page manual. But by the end, I was experimenting and she was reading the manual. We were covering the whole spectrum and, yeah, definitely helping each other. She was always dragging things in here and we were sending things back-and-forth…. We were always working together trying to figure out something that will go…with science and social studies, math and reading; to see if there is something we can correlate.

Thus, collaborating resulted in advancing technology integration for both teachers. Sheryl’s comment is of interest because it shows how the two teachers chose to collaborate and that knowledge was shared through that collaboration. Not only did both teachers gain knowledge about technology integration, but they also helped each other with instructional ideas and resources. Although initially processes and tasks associated with technology integration representative of SoC 3 Management and LoU IVA Routine were dominant, through their collaboration both teachers began to focus on what was beneficial for student learning, an aspect of SoC 4 Consequence and LoU IVB Refinement (Hall & Hord, 2006).

By 2010, all six of the six teachers were competently using the interactive whiteboards and electronic response system. During the 2009-2010 school year, a new technology innovation was introduced, a student laptop computer program was implemented in their classrooms. These student laptop computers were purchased by parents, but managed by the school. The descriptions of teacher collaboration developed from an emphasis on learning to use interactive whiteboards and an emphasis on sharing resources, ideas, and websites to better use the student laptop computers. In addition to gaining knowledge, teachers were searching for different methods to use the innovation, a characteristic of Level IVB Refinement (Hall & Hord, 2006).
Together, teachers concerns led them to focus on refining their use of the technology to make the subject matter content more meaningful for their students, consistent with SoC 4 Consequence (Hall & Hord, 2006, p. 140).

The fifth grade teachers described their collaboration during the 2010 interview. Digital immigrant Leah indicated she learned from the digital bridge Kellie whose technology skills were more advanced. Kellie confirmed that she provided help to Leah, but added that they were beginning to collaborate on developing projects as a learning tool for students.

If Leah has a question, I'll answer her and help her…. She and I really try to work together when she can fit in the element of her project into mine. We were doing this as part of my reading project for this quarter. We usually do three books and this time we did two for me and one that's a science related book that requires students to use technology.

The third and fourth grade teachers described similar collaborative relationships that developed in a sequential pattern. First the collaboration centered on receiving and providing help to learn to use the technology. Next, the collaboration focused on sharing ideas and resources. Finally, teachers began collaborating on projects. Each of these states of collaboration raised teachers’ placement on the Stages of Concern and Levels of Use (Hall & Hord, 2006). However, while fifth grade teachers Leah and Kellie remained at SoC 4 Consequence and SoC 5 Collaboration and LoU IVB Refinement as they developed small projects together, the third and fourth grade teachers began to develop cross-curricular project based learning (PBL) units.

Fourth grade teacher Sally described her collaboration with colleague Deanna to develop a cross-curricular PBL, which they referred to as the state project. The fourth grade teachers worked together on this year long, multi-faceted project, during which each child in the grade level was assigned a state and did a series of projects concerning that state. Among the projects,
students used their laptop computers to complete research on their state and to create reports, travel brochures, presentations on endangered animals, compare the cost of traveling to their state capital by car and plane, and to create a wiki webpage for their state. They also collaborated to compare and contrast states within geographical regions. These projects culminated in a portfolio and a “state fair” at the end of the year at which students demonstrated what they learned. Sally described how their collaboration developed, saying

Me and Deanna worked a lot together. When she would want to learn how to do things, I would show her how to do it because she tends to be less comfortable with the technology and…we were in the same grade level…. I kind of started the state project and had a bunch of English and social studies stuff that we were doing. Then she got on board by adding some things she already taught, like…she added a weather project…. Deanna and I have done the basis for the state project together so we just took some things that we could kind of build on together.

Because of this project, fourth grade teachers Sally and Deanna began collaborating on projects earlier in the process than teachers did in the other grade levels. Therefore, because these teachers had an existing collaborative relationship, formalizing a project-based unit related to the state project was a natural progression.

The collaboration between the fourth grade teachers was similar to the collaboration described by the third grade teachers when PBL units were required by the administration, a topic addressed in the final interviews in 2011. Maria, who described relying on Sheryl for help in the prior interviews, described their partnership as consisting of working together using technology resources to develop their unit. She explained,

If it is a reading site that has math on it, she will just send it to me, and I'll send one vice versa….. A lot of hours went to the planning [of the PBL unit]…. We sent a document back-and-forth [to create our project based lesson plan]…. We watched each other [while teaching with technology], because I'm never in her room watching what she's doing [with technology].

In addition to working together on projects, Maria cited that the pair observed each other’s classes and noted that it was helpful to see what the other was doing, especially when a new
technology tool was being used. This was the point at which these teachers began to reach SoC 5 Collaboration focused on “coordination and cooperation” (Hall & Hord, 2006, p. 140) and LoU V Integration “combining [their] own efforts to use the innovation with related activities of colleagues” (Hall & Hord, 2006, p. 160). However, to reach these highest Stages of Concern and Levels of Use (Hall & Hord, 2006) and combine one’s efforts with those of colleagues, teachers would need to seek ideas from colleagues beyond their own grade level.

Teacher collaboration stood out as a major informal teacher-initiated change process by which knowledge was transferred among the six teachers and by which five of the six teachers learned to integrate technology. This finding is consistent with the previous findings or researchers (Frank et al., 2004; Penuel et al., 2013; Sahin & Thompson, 2006; Shapley et al., 2006) who found these collegial relationships to be an important factor in driving technology integration. Teacher collaboration also marked the point in the process at which teachers began to reach the Impact Stages of Concern and the coinciding Levels of Use (Hall & Hord, 2006).

Teacher collaboration began out of a need to learn to use the technology and manage day-to-day tasks, representative of SoC 3 Management and LoU III Mechanical Use. Next, teachers began to progress towards SoC 4 Consequence and both LoU IVA Routine and LoU IVB Refinement, because their use of the technology stabilized and they were concerned with refining their use of technology to better benefit students (Hall & Hord, 2006). Finally, as concerns were raised towards SoC 5 Collaboration and LoU V Integration, collaboration was not limited to grade level co-workers. Teachers described learning from, sharing ideas with, and collaborating with teachers across the three grade levels and subject areas. This collaboration laid the foundation for a second informal teacher-initiated change process which emerged within the school, the development of informal communities of practice.
Informal Communities of Practice

Teacher collaboration fueled the second teacher-initiated change process that facilitated technology integration, informal communities of practice. Communities of practice are described in as “groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly” (Wenger, 1998). There were several communities of practice within the school. The third, fourth and fifth grade teachers were members of a community of practice involving best practices for using student laptop computers. The third and fourth grade teachers were also members of a community of practice as they were located on the same hallway and often provided help and ideas to each other. These communities of practice also incorporated other members of the faculty, such as the art and music teachers and the technology staff when they collaborated on projects with the third, fourth, and fifth grade teachers. The enterprise that drew these communities of practice together was the pursuit of technology integration and ways to continuously improve classroom instruction. The mutual engagement the teachers employed involved sending each other lesson resources, ideas for technology integration, and observing the lessons of other teachers within the communities.

A shared repertoire (Wenger, 1998) among the teachers developed in several steps. First teachers sought help from colleagues to learn how to use technology innovations and improve their teaching with these resources. Once these innovations were better integrated, teachers sought ways to improve and add variety to lessons, aimed at achieving more complex use of the technology in classroom instruction to increase student engagement and learning. The communities were informal and teachers met when they had common planning times during the school day, during scheduled job-embedded planning days, and informally through teacher interactions.
Researchers report that communities of practice increase teacher collaboration (Frank et al., 2004; Frank et al., 2011; Penuel et al., 2013; Sahin & Thompson, 2006), foster technology integration (Kopcha, 2010; Kopcha, 2012; Vavasseur & MacGregor, 2008), and serve as a vehicle for school improvement (Sigurðardóttir, 2010; Williams, 2013). However, Kopcha (2012) also noted that the specific school environment was vital to the success or failure of communities of practice. Participants in this study indicated that informal communities of practice developed as an extension of the existing collaboration within grade levels, with the tech team, and with digital native and digital bridge teachers across grade levels.

Teachers of varying technology proficiency indicated that they learned much from other teachers. This was especially the case with digital immigrants who found collaboration with digital natives and digital bridges particularly helpful. For example, in the 2008 interviews, Deanna, a digital immigrant and fourth grade teacher, indicated that she “learned more [about technology] from Sheryl…[and] fellow teachers” than from classes and seminars she has attended.

Participation in communities of practice to gain knowledge was noted and described specifically by many of the teacher participants, including third grade teacher Sheryl, who said,

The other teachers, they're awesome. We are very close. I feel comfortable asking anyone for help. Some of our best conferences are in the cafeteria at the tea container and our problems are solved in the mailroom while we are getting mail or getting a Diet Coke.

Consistent with Sheryl’s description in the above quotation, in the 2010 interviews, several teachers commented that informal interactions and conversations between teachers were important to the change process of integrating technology. Although brief and informal, these conversations provided teachers with the help and resources to become successful in integrating
technology and exhibit the shared repertoire and mutual engagement consistent with communities of practice (Wenger, 1998).

All six of the teacher participants interviewed for this study described situations in which they and the other teachers with whom they interacted helped each other by sharing knowledge, ideas and resources, and by engaging in peer observations. Figure 4.3 below illustrates these three facets of informal communities of practice in the school.

![Informal Communities of Practice Diagram]

Figure 4.3. Informal communities of practice change process strategies.

**Sharing knowledge.** Fourth grade teacher Deanna encapsulated how teachers learned about technology from each other when she reflected on the way teachers learned to use new technology. She recalled that her fellow teachers were very helpful. We learned from each other, one helping another. Sheryl, the third grade teacher, was very helpful. She was one of our best resources…. She taught me a lot about computers …. Sheryl helped with basic skills and techniques like [Microsoft] Word. We had a lot of collaboration and we really learned from each other. We had workshops at the beginning, but because the workshops- they go so fast- unless you do it right then, you don’t remember. One teacher will remember one thing and another would remember something else. But teachers helping teachers was one of the main ways we learned.

Like Deanna, all six of the participants made statements which indicated that they collaborated with fellow teachers in an informal support system to learn about technology. This kind of
interaction enabled teachers to learn how to better integrate technology and is representative of communities of practice in which members of the community with a common interest learn how to do something better (Wenger, 1998). The teachers’ willingness to help each other also exhibited the mutual trust that Tschanen-Moran (2009) deemed central to the success of a community of practice. However, the kinds of support described by the teachers in the 2008 interviews differed based on teacher’s proficiency level with technology. The less proficient digital immigrants relied on the more proficient digital natives and digital bridges (Fryer, 2006; Prensky, 2001) to gain basic knowledge. The more proficient digital natives and digital bridges called on their colleagues to troubleshoot when problems with programs or equipment arose and they share ideas and lesson resources such as websites. As a result of these interactions with more proficient teachers, the less proficient, digital immigrants like Deanna indicated that they became more proficient themselves. Fifth grade teacher Leah, also a digital immigrant, mentioned specific ways that teachers with more technology expertise helped her gain knowledge, explaining

They are really supportive; we have a really supportive environment. The younger teachers are also very supportive. I have a niece that teaches here and she helped me a lot. She'll teach me a few things that are particular to the environment at the school. It's fabulous, I can go to anybody. Some teachers I know are so bright. My [grade level] partner is a lawyer, but she went back to school in education and took a lot of technology courses so she is really good at it. She supports me all day long, anytime I need help. So I feel very supported. It's really been fun and incredible for someone who started teaching with knowing nothing [about technology] to now have all this at my fingertips.

Deanna and Leah’s statements specifically credited other teachers as providing support that was crucial in their own skill development. This collaboration helped these digital immigrant teachers, who originally struggled with using technology to affect their classrooms and were at SoC 2 Personal and LoU II Preparation, to begin day-to-day use of technology and move to SoC 3 Management and LoU III Mechanical Use (Hall & Hord, 2006).
Fourth grade teacher and digital native Sally related similar experiences in obtaining help from fellow teachers. However, the support she described included not only help in learning to use the technology, but in troubleshooting, or solving technical problems with equipment or programs when they arose during a lesson. She commented that

I feel like if I want help doing something, I can get it from other people. Me and the other teachers around me, we regularly ask each other for help when we have questions [about technology equipment or programs] or for troubleshooting, especially if we can't leave our classrooms. Today somebody sent over a kid because they couldn't figure out something on a Word document and I helped them.

Although Sally’s statements locate her partially at SoC 3 Management and LoU III Mechanical Use, her ability to help the others indicated that use of technology was becoming stabilized and part of normal instruction, a characteristic of the LoU IVA Routine. These statements provided insight into the ways knowledge was transferred through the informal communities of practice and helped teachers to better integrate technology (Wenger, 2009). These findings also coincide with the research of Kopcha (2012) who found that teachers used communities of practice often for troubleshooting and sharing ideas.

**Sharing ideas and resources.** In addition to the help teachers received from colleagues to learn about technology, five of the six participants mentioned sharing ideas about student projects and integrating technology into those projects in the 2010 and 2011 interviews. Third grade teacher Maria described that when searching for ideas to use in her classroom, having access to the help and talents of other teachers was very beneficial. She explained,

I enjoy borrowing ideas more than I do creating them…. I think having access to their abilities, because they have more background in technology, has help me as much as anything. A lot of times it's just a matter of using it and using it again. But I think the people with the more recent technology and computer background are the ones who are so much more comfortable with it rather than those of us who are having to learn it for the first time.
This statement indicated that teachers relied on the ideas of others to improve their use of technology. Digital immigrants like Maria recognized that exposure to talents of other teachers and “borrowing” their ideas improved their skill in technology integration. In this vein, fourth grade teacher and digital immigrant Deanna expanded on specific ways that teachers shared ideas and solved problems, noting that

It’s great! I’ve learned so much from the teachers that have been around me, around in the hall. If someone doesn’t know how to do something we need to do [with technology], someone else does. They are great about sharing and showing shortcuts. Actually, Sheryl has shown me a lot and, of course, Sally, too. I think they are great in sharing information that needs to be shared… It’s a support system; they are willing to help and figure out. Headmaster [an online content management and grade book program] was a problem and we worked together on to rectify the problems. The colleagues are great! They also give ideas for websites; in fact, I got two today from Maria. We share ideas rather than just tech help.

The community of practice gave teachers a medium by which new ideas concerning teaching with technology could be diffused through the school environment. As the community of practice developed, it became a support system, and as Deanna indicated, teachers were “willing to help” and “share ideas rather than just tech help.” Sharing ideas to improve practice also reflects that these teachers engaged in the shared repertoire, mutual engagement, and mutual trust needed for in a community of practice to be effective (Tschannen-Moran, 2009; Wenger, 1998). This was further exemplified by three of the participant teachers, third grade teachers Sheryl and Maria and fifth grade teacher Leah, who indicated that the kindergarten resource and science teacher shared an important idea about how to search for websites which helped them improve the way they found resources. Leah described this idea, explaining that

I've learned to pick interactive websites and let the kids do things that are not just words on the screen. I watched the Kindergarten resource teacher, one of our teachers at our school, because every day she had something that the kids are doing that she finds. She said anything you are trying to find, look for the word interactive- interactive fractions, interactive division, and interactive money.
Both third grade teacher Maria and fifth grade teacher Leah specifically mentioned that another teacher shared an important strategy to find websites to use the interactive whiteboard. These tips and interactions led teachers to improve their practice by exposing them to new ways to acquire resources for technology integration. As a result, in addition to sharing ideas, five of the six teachers mentioned that they routinely “shared websites” with other teachers in a variety of grade levels and subjects. Third grade teacher Maria discussed sharing websites with a variety of teachers when she found useful resources for other classroom and co-curricular (enrichment) teachers. According to her,

We are always sharing websites. Leah, Deanna and I send websites back and forth for math and science if anyone finds anything new. Sheryl is always sending something to me. If it's a reading site that has math, she will send it to me and I'll send it to her, vice versa. I think some people have their favorites so they go to all the time, but you have sent sites, Rita [the librarian] sends sites to us. I think anytime anyone who finds anything that’s worthwhile, they send it. I'll send websites on a weekly basis. I quite often send websites down to pre-K when we have things that come in. The Mackey websites [a subscription for educational websites] that comes [through email] always has good things for everybody. I’ll send some to the music teacher and to the art teacher.

This practice of routinely sharing websites and resources also led to teachers conferring on teaching ideas and content across subjects and grade levels. Fourth grade teacher Sally described that these interactions improved the content and ideas for her lessons, explaining that

I think what has helped is bouncing ideas off of each other and saying this might work better this way, or I did it this way. I liked when we did this. It would help me tighten up what my plan was when I worked with other teachers.

Additional participants also indicated that appreciated the interactions they had across grade levels to make sure students were adequately prepared for the tasks they would have to accomplish. Third grade teachers recounted that “we've talked to Sally and Deanna about what they need for fourth grade and what we can do to get the students ready. I think that's the main thing, to have them ready for fourth grade.”
This concentration on seeking new ideas for student learning showed that teachers focused on what was beneficial for student learning, an aspect of SoC 4 Consequence and LoU IVB Refinement. The participants were also working with other teachers to improve technology integration and the experience of students in all grade levels, characteristic of SoC 5 Collaboration and LoU V Integration (Hall & Hord, 2006). These statements provided additional evidence consistent with previous research (Vavasseur & MacGregor, 2008; Kopcha, 2012) which indicated that sharing ideas and resources and discussing educational ideas fostered communities of practice as a support structure for teachers to improve their educational practice when integrating technology.

**Peer observations.** In the 2008 interviews, several of the teachers indicated that they would benefit from the opportunity to see demonstration lessons or participate in peer observations in other teachers’ classrooms. Third grade teacher Maria said that to better utilize interactive whiteboards in her classroom, she would like to see “demonstration lessons” because they “would probably be the biggest help to us, as far as utilizing the [interactive whiteboards]; to see how different people utilize them.” Fourth grade teacher Deanna reflected this desire to see “how they use [the interactive whiteboard] in their classrooms” because doing this would “really show me how it did enhance learning, and it wasn't just [used as] another activity added on.”

Because teachers found watching lessons taught by others and demonstrations helpful, Principal Lafontaine often suggested that teachers observe how peer teachers used technology in their classrooms. Several times a year, in preparation for a “teacher review meeting,” a quarterly meeting with Principal Lafontaine to discuss teachers’ progress with technology integration, each teacher would observe another teacher, fill out an observation form, and discuss it with the
teacher they observed and at their meeting with the principal. In her 2011 interview, Principal Lafontaine described these peer observations, noting

A teacher can go in another teacher’s classroom in a walk through [a short peer] observation and it is a healthy professional, environment. We had that and needed to capitalize on it. It’s a good way to see what other people are doing that can help them with what they are doing…. To see a different way of doing things or a better way. It’s kind of little mini-conference, to see what everyone is doing. Seeing other classrooms also helps vertical alignment. Teachers see grade levels earlier and later than theirs, so they know the children.

Although initially implemented by the administration during the 2006-2007 school year as a part of the teacher review meeting system, the teachers noted that these peer observations were helpful in learning what others did in their classrooms. These observations, although started by Principal Lafontaine, became an important aspect of the community of practice within the school.

In the 2011 interviews, peer observations were identified by four of the six teacher participants as a factor which drove technology integration and the change process. Fourth grade teacher Sally said that these peer observation opportunities were beneficial to improving her practice and commented that

A couple of years ago we started doing teacher review meetings and peer observations. I think they are pretty helpful because it forces you to look at things you probably don't take the time normally to think about. I often go see Sheryl and Kellie’s classes because they teach similar things to me. They are always using some technology thing or new project. I can ask them about it and try to make a bridge between third and fifth grade. I think they are pretty helpful to see.

Sally’s statement further supports peer observations as integral to effective communities of practice. She first recalled that the peer observations helped her better integrate technology by viewing what the other teachers did in their classrooms. Additionally, she valued the opportunity to discuss ideas with teachers she observed which encouraged mutual engagement and a shared repertoire (Wenger, 1998) between her and the third, fourth, and fifth grade teachers. Finally,
because a mutual trust was present, the teachers who participated were willing to share and to deprivatize their instruction (Tschannen-Moran, 2009; Wenger, 1998).

In addition to the observations completed for meetings with the principal, when other innovations were introduced at the school, teachers who implemented them first often opened their classrooms to anyone who wanted to view the new innovation. For example, the third grade teachers related visiting Kristin’s second grade classroom “when they first set up those little pod things and put those into the curriculum.” The innovation they were speaking of was a computer arrangement in which the teacher placed one computer per group of four students comprising the pod. This arrangement was implemented to give the second grade students additional technology access in a group setting. Maria also mentioned that after she and several other teachers attended training on Kagan strategies for student grouping and classroom management, she had “a lot of people that would come in when we were doing something with Kagan. I would have people ask if they could come watch the Kagan even though it isn't so much technology.” Therefore, these observations became opportunities for teachers to expand their knowledge of a variety of instructional strategies.

Teachers would also informally drop by another teacher’s classroom when they heard of something they wanted to learn more about. Maria related that her co-worker, Sheryl, “will go and watch something that was word-of-mouth” and then suggest that “really we should take more time to do that.” Sheryl also mentioned that even when they were at lunch, they watched the kindergarten science resource teacher, whose classroom was visible from the lunchroom, and learned from what she was doing. Speaking of this occurrence, Sheryl said “we are watching the kindergarten resource teacher’s room every day to see what she's doing in kindergarten. She uses her board for so much more than just a whiteboard. I found that out just by watching her
during lunch.” The third grade teachers also said that that participation in peer observations of teachers at other grade levels caused them to observe each other more often. These findings were consistent with the recommendations of Tschannen-Moran (2009) which indicate that a community of practice should include mutual trust, reflective thinking, and lead to de-privatization of teaching. Teachers’ willingness to open their rooms to visitors demonstrated that teachers participated in a reflective and supportive environment and had de-privatized their instruction.

As teachers participated in peer observations and communities of practice, their concerns and use of technology progressed and they moved higher on the Stages of Concern and Levels of Use scales (Hall & Hord, 2006). The interactions described indicated that teachers’ experiences were consistent with those of SoC 5 Collaboration. They also achieved the very important LoU V Integration, as technology became integrated seamlessly into their classroom. Having achieved this level, the constant focus of communities of practice on trying to do something better (Wenger, 1998) drove some teachers towards SoC 6 Refocusing and LoU VI Renewal, which are the highest stage and level in the CBAM model (Hall & Hord, 2006).

Those teachers who reached SoC 6 Refocusing and LoU VI Renewal (Hall & Hord, 2006) were willing to experiment with technology, fail, seek additional information, and try again until success was achieved. These teachers possessed expertise in technology and were eager to share their new and innovative ideas with colleagues within the communities of practice. They set examples the other teachers followed and, consequently, became informal leaders within the school whom others sought out to extend their own use of technology.
Informal Teacher Leadership

The third informal teacher-initiated change process that facilitated technology integration was informal teacher leadership. Silva et al. (2000) described teacher leaders as those members of a faculty and staff with expertise in specific areas, who play a vital role in teachers’ everyday experience. These individuals in informal leadership capacities collaborate with others, discuss common problems, share best practices, participate in collaborative problem solving, and motivate faculty members (Silva et al., 2000, p. 781). Additionally, teacher leadership was described in the research (Staples, Pugach, & Himes, 2005) as one of the scaffolds that supported technology integration. Several teachers were identified by participants as providing expertise that was integral in the technology integration process. These informal leaders were among the earliest adopters of technology and were able to share their ingenuity and assist in the change process that occurred at the school. Two of these informal leaders, second grade teacher Kristin and librarian Rita, eventually became members of the tech team at the school. Another teacher leader, third grade teacher Sheryl, remained a classroom teacher throughout the period of the study. Sheryl was a participant in the study, but Kristin and Rita did not meet the selection criteria. Because of their leadership contributions, Kristin and Rita are discussed as non-participants.

**Kristin.** Kristin Allen was mentioned by all six of the interview participants in each round of interviews for opening her classroom for observations, being available to model lessons, and serving as an example of best practices within the school. She was specifically described as “creative” by two of the teachers, Maria and Leah. Maria expanded on this description and commented that

Kristin did wonderful things with her interactive whiteboard. Kristin was very creative….. She jumped right into it…. One of the initial things that we wanted to see
was Kristin. She was so creative that she can actually come in and teach classes or show us how to do something.

Originally an innovative second grade teacher, Kristin’s classroom became a successful model of technology integration for others to observe. She was also specifically identified by name by three of the teacher participants as the teacher whom they credited with beginning the PBL innovation at the school. These comments about Kristin were consistent with the description of a teacher leader given by Silva et al. (2000). She became a vital part of teachers’ learning experience, collaborated with them, shared best practices, and motivated them with her creativity and enthusiasm. As time went on, Kristin’s leadership was utilized and she was moved into a technology resource teacher position in which she could share her talents with the whole school in a support capacity.

**Rita.** The school librarian, Rita was also mentioned by all six of the participants as providing technology resources, such as websites and wikis that could be used by the classroom teachers. As a librarian and enrichment teacher, she had a flexible schedule and was often available to provide teachers with resources and help during the school day. Commenting on Rita’s leadership, Maria noted that

Rita is really good about sending sites to us…. She’s been a wealth of information…. I really like the emails she sends, and of what she sends, two-thirds are things that I can use or store for usage of a later time.

In this statement, third grade teacher Maria related that Rita often shared resources with the classroom teachers, assisting them in integrating interactive websites and ideas into the classroom. Rita also became a campus resource for developing Web 2.0 tools, such as wikis, for the classroom. Fifth grade teacher Kellie mentioned that Rita helped her develop wikis that she used for several projects in her classroom. Fifth grade teacher and digital immigrant Leah also shared that she “did ask Rita to help me with the wiki on habitats,” showing that the idea of using
wikis had spread to teachers at all proficiency levels. Rita expressed interest in attending tech team meetings and sharing ideas she had with the tech team and the principal. As a result of her interest and leadership, she was invited to become a member of the tech team.

Like Kristin, because of Rita’s inclination towards technology, she collaborated with teachers, shared lesson ideas, and became a part of their teaching experience (Silva et al, 2000). Because of the technology integration innovation, teachers and staff members such as Kristin and Rita, had the opportunity to demonstrate a level of expertise and a willingness to collaborate that was needed to drive technology integration. As a consequence, Kristin and Rita’s leadership was recognized by the administration and they were moved to positions from which they could help a wider range of faculty members.

**Sheryl.** In addition to teachers who were eventually identified as tech team members, classroom teachers also had an impact on the school as teacher leaders. Third grade teacher Sheryl was identified by three of the six participants, including both fourth grade teachers Deanna and Sally and fellow third grade teacher Maria, as the individual they relied on most among all of the third and fourth grade teachers for assistance and ideas about using the technology. Therefore, because of the expertise she exhibited, she became an informal leader among the third and fourth grade teachers and the person they sought when they were faced with challenges with the technology innovations.

Maria, Sheryl’s third grade colleague, related that she “had to rely on Sheryl to learn a lot.” Maria explained that one reason Sheryl was so helpful was because “she went back [to school] and one of her [areas of certification] is in computers and she learned and she brings it into me.” Both fourth grade teachers also named Sheryl as a model who helped them learn about technology. Sally mentioned that “Sheryl liked to fiddle around with [the technology] and she
would show me” how to use it, indicating that although Sally was a digital native, she valued the skills and expertise of a more experienced teacher when using technology. Deanna mentioned several times throughout her interviews the impact Sheryl had on her learning process. Deanna described Sheryl as “very helpful” and “she was one of our best resources.” Deanna maintained that Sheryl was instrumental in helping “with basic skills and techniques like [Microsoft] Word.” These descriptions demonstrate that Sheryl also fits the description of a teacher leader posited by Silva et al.’s (2000) because she was a vital part of the third and fourth grade teachers’ everyday practice and a colleague with whom they collaborated, discussed challenges, and shared best practices.

Interestingly, none of these informal teacher leaders were digital natives, but played instrumental roles at the school as digital bridges. Kristin, who was in her late forties to early fifties during the years covered in this study, was the youngest teacher leader identified. However, with years of experience and technology expertise, these individuals put forth the effort to become technology savvy for the benefit of their students. Also, having not grown up in a world with the technology tools and resources available today, they had an understanding of the hardships digital immigrants faced when integrating technology. This finding could imply that these digital bridges were better equipped than digital natives to help the digital immigrants who struggle with technology integration. According to Emanuel (2013), such teachers find it relatively easy to integrate various technologies into their lessons, especially when they believe the technology is beneficial to student learning (Randsdell, Kent, Gaillard-Kent, & Long, 2011). Moreover, once these middle-aged veterans decided to use instructional technology, they were better than their younger, less experienced colleagues at applying newly acquired knowledge and
were more likely to involve students in using the technology (Russell, Bebell, O’Dwyer, & O’Conner, 2003).

The leadership and influence of these informal teacher leaders was not limited to helping classroom teachers integrate technology. Principal Lafontaine also relied on their expertise and the support they provided to make informed decisions about schoolwide changes. For example, the schoolwide PBL initiative was implemented based on input Principal Lafontaine received from teacher leaders and information she gathered through the teacher review meetings and peer observations. She explained,

We knew that most of our teachers were already doing a form of PBL, but had not formalized it in their lesson plans. Our PBL requirement simply took what our teachers were already doing and organized it in a more formal way. Also, the administration was approached by a few teachers who had already come to that same conclusion and were eager to implement PBL into our existing curriculum, so I knew we had some support already built in to the faculty. At first some teachers were doing it only because it was a school requirement, but as time went on, they realized it was just a more formalized way of doing what they were already doing and began to embrace it. At the end of every project-based unit, we met with the teachers for reflection. In all cases, the teachers responded that it was easier than they thought, much more fun [than the way they taught the lesson previously], and the students seemed to learn more. They agreed they would do it again.

The project-based learning initiative was a result of teachers who reached SoC 6 Refocusing and LOU VI Renewal (Hall & Hord, 2006) and had begun to implement major changes in the way they used technology to present lessons in their classrooms. Principal Lafontaine’s account indicated that teacher leaders within the school approached her concerning these changes and were subsequently utilized as informal leaders to support the faculty in implementing PBL. However, she also related that some teachers were not enthusiastic about the new requirement and would need encouragement and support. Therefore, when the decision was made to implement PBL school-wide, she was able to provide examples and support as a form of JEPD, resulting in a successful implementation. She also emphasized that after the projects, she
used the teacher review meetings as a time to reflect on teachers’ experiences with PBL. Principal Lafontaine’s actions align with the recommendation of Brouwer et al. (2011) and Pancucci (2008) that communities of practice are more effective when administrators support them and engage in a shared repertoire with teachers.

Thus, the formal support provided by the principal through professional development and ongoing encouragement through teacher review meetings and peer observations, provided in-house support staff and set in motion JEPD such as teacher-initiated collaboration. Collaboration between colleagues evolved into teacher-initiated informal communities of practice from which informal teacher leaders emerged and provided expertise, support, and encouragement for ongoing technology integration. The formal and informal changes processes led to successful technology integration, additional innovations, and substantial changes in the way teachers taught and the way students learned.

Changes in Teaching and Learning

Technology integration occurred as a result of the formal change processes and informal teacher-initiated change processes, altering teaching and learning at the school. These changes were explored through the second a priori theme, changes in teaching and learning. Over the three rounds of data collection, the teacher participants described five changes in their instruction that affected students’ learning experiences. These changes included the extensive use of technology, student-centered instruction, differentiated instruction, increased student engagement, and peer tutoring and are represented in Figure 4.4.
Extensive Use of Technology

The first change in teaching and learning was the extensive use of technology in the classroom. Each of the six participants indicated that technology integration resulted in changes in their teaching methods. As mentioned previously, before technology integration began, some teacher participants thought of technology as an “accessory” or “enrichment” for students. However, as teachers gained proficiency, their thinking changed. Technology became engrained in teaching and learning throughout the school. During the first round of interviews in 2008, two years after technology integration began, third grade teacher and digital bridge Sheryl indicated that “everything in this room runs off the interactive whiteboard, it truly does.” The same was true of digital immigrants such as fourth grade teacher Deanna. Like Sheryl, she came to find the technology indispensable, commenting, “it is one of those things that you are fearful of, but then once you have it, it is like your watch, you can’t live without it.”

The second round of interviews occurred two years later, in 2010. Extensive use of the initial implementation continued, and at the beginning of the 2009-2010 school year, the students of each participating teacher had a laptop computer for school use. When recounting the decision to implement the laptop computers, Principal Lafontaine stated,
It was simply an issue of keeping up with the times and providing our children with the necessary tools and skills to be more productive in their academic work. Teachers thought our children were quite capable of functioning with the responsibility of an individual laptop and deserved the chance to learn with this type of technology.

Because students now had one-to-one access to technology, teachers adjusted their activities and lessons to include using technology with a greater frequency. In this regard, Deanna commented,

Each year something else is added and I feel more comfortable with it. Each year I’ve learned to change my old lesson plans to accommodate the laptops. I’m kind of more acclimated to using the laptops as the year has gone on and I’ve found more and more ways to use them.

The other participants concurred and made similar statements concerning the changes in their classrooms due to the laptop computers. Third grade teacher Maria, for example, commented that although she was currently using the student laptop computers “more…as a supplement to my daily lessons,” she wanted to do more “ongoing projects that…last for longer than just daily activities.” Similarly, fourth grade teacher Sally commented that in trying various technology projects, she had to adjust her instructional methods. Although as a digital native, she was willing to implement technology projects such as wikis and blogs as a part of her language arts curriculum, she realized that she needed to change the types of questions she asked to better target higher order thinking skills by asking more open ended questions. Sally noted that I try each year to add on at least one new thing. The first year it was the interactive whiteboard, then the votes, and then wikis and blogs and e-mail projects. I've had trouble with the blog and wiki, not so much in the technology, [but in]…trying to come up with open ended questions. I was focusing too much on closed ended questions where you have to write a right or wrong answer. So I'm working on it so that it’s more open ended.

Statements like these from Maria and Sally reflect an effort by teachers to improve their instruction so that students used technology often and in a variety of ways that fostered not just technology use, but also higher order thinking. These efforts to refine the kinds of technology
projects to include ongoing projects and those that contained higher order thinking opportunities indicated that teachers were concerned with enhancing student learning. This interest in what is best for students and the related efforts to make changes are indicative of SoC 4 Consequence and LoU IVB Refinement (Hall & Hord, 2006).

By the time the third round of interviews was conducted in 2011, teachers were able to reflect on the changes that had transpired in their classrooms over the five years of technology integration. They had used an interactive whiteboard for five years, student laptop computers for two years, and were collaborating on PBL units. Deanna, who stated in the first set of interviews that she was “fearful” about using technology, now thought that technology had considerably changed her teaching:

I don’t know what I would do [in my classroom] without the laptops, the interactive whiteboard, or the document camera. They have really revolutionized my teaching…. Now, all the lessons plans are geared towards the laptops…. Curriculum is developing from the technology.

Deanna’s observation that curriculum was developing from the use of technology was evident in the comments given by four of the six teachers in the 2011 interviews. Third grade teacher Sheryl reflected this change in curriculum when she commented on how different her classroom became because of technology. She shared that her classroom was now so dependent on technology that it could not function without it, noting that her classroom instruction has changed just in the last ten years – what we started out doing and where we are doing now. Years ago, technology depended on us; now, we depend on it. We are very dependent on the technology. If I ever actually forgot my laptop at home, I would panic because basically everything we do now revolves around the technology. If it is not my computer, it is their computers.

Fourth grade teacher Sally also reflected in the 2011 interviews on the changes that had come about as a result of the technology integration. She said that it was more than just a change, but a shift in the way teachers viewed the curriculum, explaining further that
there’s such a paradigm shift in what school is now from what it was, and because of that, you have to rebuild parts of your curriculum from the ground up. I like to do that [rebuild curriculum], but it definitely takes a lot of effort on all of our parts.

Sally’s comment indicated that she, along with the other participants, were involved in reconstructing the curriculum to accommodate the technology. These findings suggested that the goal of technology integration was achieved by the six teacher participants. Each of these teachers depended upon the various technology tools as the primary media for instruction.

Having seen the results of the change process, teachers acknowledged that there was a need to significantly transform their instructional methods. These revelations placed teachers at the highest levels of the Stages of Concern and Levels of Use, SoC 6 Refocusing and LoU VI Renewal (Hall & Hord, 2006) by the final round of interviews in 2011.

**Student-Centered Classrooms**

The second change in teaching and learning that was discussed by all participants was a subtle transition from teacher-centered classrooms to student-centered classrooms. No longer were teachers the sole purveyors of knowledge, but were instead facilitators of student learning, soliciting ideas about class activities from students and taking student recommendations, and sometimes guidance, about using technology. In the initial set of interviews in 2008, third grade teacher Sheryl, indicated that her classroom was already becoming increasingly student-centered, noting that

I have become a different teacher because of [the interactive whiteboard]. I am more of a guide and the children are doing their own learning. The students are more focused, more aggressive learners – self-directed. Many times they will get up and find something I never thought to look for on the interactive whiteboard…. I’m slowly releasing responsibility from books to the interactive whiteboard for more interactive learning.

Sheryl was the only teacher who noted this change in the initial interviews. However, during the 2010 and 2011 interviews, all six of the teacher participants discussed shifting away from
textbooks as the chief source of information and to the variety of information sources available through the interactive whiteboard. This shift was accompanied by the move towards a student-centered classroom.

Principal Lafontaine noticed the decreased use of textbooks in favor of an increased use of the interactive whiteboards and technology resources. In her view, the addition of the student laptop computers and PBL changed learning in the school. She noted,

The teacher and the student form more of a partnership for learning rather than a "sit and get" from the teacher. Children are more responsible for their learning. The teacher is no longer completely center stage. Ideas and projects are all student driven, but guided softly by the teacher.

Comments from all six of the teacher participants were consistent with the view of Principal LaFontaine that the addition of the laptop computers and project based learning enabled students to learn as a participants rather than receivers of knowledge. Speaking of how her classroom changed, Maria reflected that students were interacting more with each other in the learning process. She seemed pleased that

it's different in that it’s nothing like having to listen to me all day long…. It changed teaching because you’re not in charge of the room anymore. There's a lot of children interacting. We work more with small groups now, more so than just with one other person.

Additionally, both fifth grade teachers noted that students did a considerable amount of work independently. Leah said that students “do a lot of work on their own – research on their own” and Kellie noted that students were “actually participating more when they are doing things on their laptop.” However, as instruction became more student-centered and students became more responsible for their learning, teachers realized that students differed in their ability to complete work independently because they possessed varied academic levels and learning styles, a problem they addressed through differentiated instruction.
Differentiated Instruction

A third change identified by the participants in the 2010 and 2011 interviews was that technology integration enabled teachers to better differentiate instruction to accommodate the individual learning needs of students. Four of the six teacher participants mentioned that student learning was more easily individualized because of the laptop computers and the available software. Third grade teacher Sheryl shared that the laptop computers allowed her to place students on their own learning level and to

individualize… learning…. I can go up or down to meet their needs… because they are not having to do the same exact thing…. For those who are struggling readers, I can pop them onto first grade level, or I can put them in a second grade level. Then, I can also have children who are doing analogies that are on a sixth grade level.

Likewise, fifth grade teacher Leah expressed that laptop computers allowed “the weak and strong students to find information for the lesson just beautifully.”

In addition to accommodating a variety of learning levels, the laptop computers allowed projects to vary in accord with different learning styles. Fifth grade teacher Kellie discussed the variations in projects she was able to implement in her classroom as part of a PBL unit based on a book students were reading in her classroom. The students had various choices for their final project:

I like that project-based units offer different alternatives for children who have different interests and learning styles. Those who are very techy could actually create an animated summary of the book using animated characters and the artsy people didn't have to use technology at all if they wanted to draw something.

As the above quotations demonstrate, the changes in instructional methods that resulted from technology integration had positive implications for the way students learned. As classrooms became more student-centered and teachers accommodated a variety of learning styles, the ways students learned in the classroom also changed.
Increased Student Engagement

Extensive technology use led to student-centered classrooms and differentiated instruction that accommodated different academic levels and learning styles. These changes increased student engagement. In her 2011 interview, Principal Lafontaine stated, “I honestly believe that technology integration has significantly increased the amount of classroom student engagement,” a view that encapsulated the perceptions of the six teachers. Student engagement was mentioned frequently by the six teachers in all three rounds of teacher interviews. Students were described by all six teachers and the principal as “more engaged” when using technology and four of the six teachers and the principal specified observing “one hundred percent engagement” in their classes.

In the 2008 interviews, third grade teacher Sheryl mentioned that because students are digital natives, technology is an integral part of keeping students engaged in the classroom:

The students are in a world where they expect everything to leap up and technology helps to keep them engaged. It's a different world now; we need a lot more tricks in our bag to keep them engaged. The interactive whiteboard provides that, it truly does.

Fourth grade teacher Deanna agreed, noting that “the children seem to be more attentive” and were “very involved” in their learning. During the 2010 interviews, fifth grade teacher Kellie expounded about the high level of engagement and interaction in her classroom:

I think they love technology! I think they are more interested in learning naturally if they are doing something rather than if they are listening to a teacher talk about it. They are going to learn faster and be more interested. Everyone is awake and alert and engaged rather than if they are just listening. Instead of a teacher just talking about, “What is a noun?” they are doing something on the computer or watching it on the interactive whiteboard. They are learning it and they have to participate.

As students became more engaged, they also took responsibility for their own learning. Principal Lafontaine considered project-based learning “effective in increasing student learning,” and as a result “the children were more responsible for their learning.” Fourth grade teacher
Sally reflected this idea when she said that students were “definitely more interested, more intrinsically motivated to do project-based learning.” Her fellow teacher, Deanna, said, “I think they have learned a great deal from PBL and developed independent thinking skills and comparing/contrasting.” Increased engagement and personal responsibility also gave students the opportunity to be active participants in their learning and that of their peers.

**Peer Tutoring**

The need for differentiated instruction for students at different academic levels and increased student engagement, prompted teachers to allow students to participate in a spontaneous form of peer tutoring. Five of the six teachers interviewed in 2010 indicated that students often shared their knowledge and helped each other when learning on the laptop computers. Third grade teacher Maria stated that when using the laptop computers the students “can help each other and that is where the engagement comes. When students have problems, they use peer tutoring, and some of them actually help the others so that works itself out.” Fifth grade teacher Leah shared that in her class, peer tutoring was taken to the next level, making it possible for students “to start teaching science. They will pick a subject in science and may teach it to the class. I have encouraged them to use some technology.”

As time progressed and students helped each other learn to use the laptop computers, teachers noticed students sharing their knowledge as project-based learning became prevalent in the classrooms. In the 2011 interviews, third grade teacher Maria once again mentioned that students “self-teach” and Sheryl mentioned the benefits of students teaching each other.

They had more fun finding things themselves and teaching each other how to find them. You teach one child then they can go out and help the other students around the room. The children are working with each other anytime they can. Sometimes there is a child that you just can't get through to, but they hear it from another eight-year-old and they get it.
Fourth Grade teacher Deanna also found that peer tutoring had benefits for students at all 
learning levels, adding that it gave students who did not typically stand out academically an 
opportunity to build confidence:

The kids love to share and help each other through problems. It is a way for some of 
them to shine when some of them aren’t the best students. It helps students with behavior 
problems, who are always being fussed at, to be successful.

These reflections on the changes in teaching and learning as technology became an increasingly 
integral part of instruction suggest that technology integration had become institutionalized at the 
school.

Teacher-initiated change processes, including informal job-embedded professional 
development, informal communities, and informal teacher leadership contributed to the success 
of technology integration and to the addition of other innovations, specifically the student laptop 
computers and PBL. In combination, the change processes and additional innovations resulted in 
changes in teaching and learning and raised the location of teachers on the Stages of Concern and 
Levels of Use (Hall & Hord, 2006). Table 4.2 presents the changes in each teacher’s location on 
the two CBAM scales by year of data collection and innovation.

This table summarizes the placement of teachers on the Stages of Concern and Levels of Use (Hall & Hord, 2006) based on the three rounds of data collection and the innovation being implemented. Teachers’ location in the column headed 2008 Interactive Whiteboards provides a baseline for comparison with teachers’ location on the two scales in 2010 and 2011, when the student laptop computers and PBL were added as innovations. Teachers can be located at more than one Stage of Concern and Level of Use, as noted previously. Hall and Hord (2006) explained that “in general teachers will have a conglomeration of concerns representing several of the stages, with some more strongly felt than others” (p. 142).
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<th>Stage</th>
<th>Description</th>
<th>Concerns</th>
<th>2008 Interactive Whiteboards</th>
<th>2010 Student Laptops</th>
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<th>Level</th>
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<td>VI: Renewal</td>
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<td>IVA: Routine</td>
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<td>Relies on other teachers for tech help</td>
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Teachers may also be at different Stages of Concern and Levels of Use for innovations being implemented at each data collection point. By the 2010 interviews, all of the teachers in the study had increased their Stages of Concern and Levels of Use from the first round of data collection. Digital bridges such as Sheryl began to reach SoC 6 Refocusing and LoU VI Renewal integrating the interactive whiteboards. Only fourth grade teacher Deanna and fifth grade teacher Leah, both digital immigrants, were at SoC 5 Collaboration and LoU V Integration, indicating that they had moved significantly due to collaborating with their colleagues and sharing resources. As a result, the student laptop program was developed to give students one-to-one access to technology any time they needed it during the school day.

Although the teachers likely began the year at lower Stages of Concern and Levels of Use concerning the student laptops, by the end of that year, existing teacher collaboration and communities of practice drove many of the teachers to share ideas and resources concerning the student laptop computers. Therefore, by the second round of data collection, most of the teachers had reached the SoC 5 Collaboration and LoU V Integration concerning the student laptops. Because teachers reached SoC 6 Refocusing and LoU VI Renewal integrating the interactive whiteboards, they began to reach higher levels of integration of the student laptops at a faster rate than the first integration. This sophisticated use of technology from teachers who reached SoC 6 Refocusing and LoU VI Renewal regarding the first innovations and SoC 5 Collaboration and LoU V Integration regarding the student laptops led to collaboration on resources, projects, and project-based learning units.

These project-based learning units were the focus of the third round of teacher interview in 2011 that are represented in table 4.2. By the end of this third round of teacher interviews, most of the teachers reached SoC 6 Refocusing and LoU VI Renewal concerning interactive
whiteboards and the student laptops. Many of the teachers were at SoC 5 Collaboration and LoU V Integration concerning the project-based learning units as a result of the ongoing collaboration that occurred in the school. The fifth grade did not collaborate on their project-based learning units so they remained at Stage Consequence and SoC 4 Consequence and LoU IVB Refinement. Once again the teachers reached higher levels of the Stages of Concern and Levels of Use regarding this innovation quickly as they previously reached SoC 6 Refocusing and LoU VI Renewal concerning the previous innovations.

Movement on the Stages of Concern and Levels of Use was facilitated first by formal professional development, then by teachers’ continued participation in job-embedded professional development and communities of practice. These change processes were also facilitated by the support of informal teacher leaders and technology staff members within the school. In addition, additional sources of support were identified by teachers in the interviews that were not one of these chance processes.

**Emergent Themes**

In addition to the *a priori* themes, two emergent themes were found during data analysis. The first theme was support, inclusive of principal support and student support. The second emergent theme was time challenges. Each emergent theme is discussed below.

**Support**

Support was a reoccurring theme shared by the participants throughout the occasions of data collection. Teachers relied on many different kinds of support provided by different sources. Support of colleagues and the tech team was evident in teachers’ comments about job-embedded professional development and communities of practice. In addition to these forms of
support, two specific kinds of support emerged from the data as important to the technology integration change process. These were principal support and pressure and student support.

**Principal support.** The focus of this study concentrated on teachers however, administrative support provided by the school principal emerged as a theme. Comments about administrative support were made by all six participating teachers across all data collection points whether or not the issue was included on the interview protocol. Each teacher commented that support from Principal Lafontaine was an important driver of the change process within the school and was critical to the success of technology integration. The consistency with which teachers credited the principal with supporting the innovation prompted adding the principal interview in the last round of data collection.

Two dimensions of administrative support were identified and are analogous to the two dimensions of leadership described by Blake and Mouton (1967) as concern for people and concern for results (p. 442). According to Blake and Mouton, the most effective leaders place equally strong emphasis on both dimensions of leadership, something the six teacher participants agreed Principal Lafontaine was adept at doing. The result is “work accomplishment… from committed people… [and] interdependence through a ‘common stake’ in organization purposes [which] leads to relationships of trust and respect” (Blake & Mouton, 1967, p. 442), a description the school came to exemplify as technology integration became institutionalized in teachers’ practice. Therefore, the terms Blake and Mouton applied to the dimensions of leadership were modified for this study to describe the dimensions of administrative support, that is, support for people and support for results.

**Support for people.** The support for people that Principal Lafontaine provided enabled teachers to build the knowledge and skills needed to integrate technology into their teaching.
This support occurred in three overlapping ways; (a) modeling the value of professional development, (b) encouraging teacher participation in professional learning activities, and (c) advocating for technology integration.

Principal Lafontaine described herself as “a firm believer in professional development,” a belief she modeled throughout the span of this study. From the beginning, she participated alongside teachers in professional development activities, including the 2006 Summer Institute and other on-campus training sessions. She also accompanied teachers to a number of technology workshops and conferences held off-campus. By modeling the value of professional development, she lent support to teachers who might otherwise have been reluctant to expose how little they knew about using technology.

Closely related to modeling the value importance of professional development, Principal Lafontaine encouraged teachers to participate in a variety of professional learning activities. During 2006-2008 school years, the first years of technology integration implementation, she used several approaches to address the learning needs of teachers on-campus rather than off-campus. One approach was to have the tech team offer workshops based on the identified needs of teachers. Another approach was to contract with external consultants to conduct schoolwide workshops as well as in-class demonstrations. However, the most effective professional learning activity she initiated was to capitalize on the talents of the more technologically proficient teachers and staff, pairing them with teachers who were struggling to “help as a buddy system” as she described it. The more proficient of the pair opened her classroom for peer observation, assisted the struggling teacher when glitches arose, and provided instructional help and ideas for using technology. According to Principal Lafontaine, these buddies also did a lot of

Hand-holding, listening, and saying it would be okay. The teachers [being assisted] were concerned about [learning the technology] and wanted to learn about it. [With the buddy
system,] the teachers were not in it alone; there were people in there to support and repeat. It was absolutely effective and helped us get where we are today.

The buddy system enabled teachers at the lower Stages of Concern and Levels of Use (Hall & Hord, 2006) to integrate technology with greater success. Pairing teachers in this way not only boosted the confidence of teachers experiencing difficulty, but also made deprivatizing one’s practice accepted because of the natural way it occurred between buddies. As important, the buddy system laid the foundation for teachers to develop informal communities of practice, discussed earlier in this chapter.

As teachers gained proficiency with technology integration, Principal Lafontaine encouraged them to pursue their own professional learning interests and distributed information about professional development opportunities that were available off-campus. Third grade teacher and digital native Sheryl summarized the comments of other participants, noting that

any research you want to do, any class anyone wants to visit, any professional development – she's always there. She'll send anyone [to trainings or conferences], anywhere, anytime. She always sends us the state educational resource center information [about workshops and classes] and we piggyback on trainings at local public and private schools.

By supporting people, both those to whom technology integration came easily and those who struggled but were sincere in their efforts, Principal Lafontaine formed the foundation for building the “‘common stake’ in organization purposes” that Blake and Mouton (1967, p. 442) described.

Finally, Principal Lafontaine supported people through her advocacy of technology integration, much of which was expressed in the effort she put into helping teachers achieve success. From the start, some teachers were overwhelmed by the technology itself, a feeling that was made worse by the expectation that they were to integrate technology into their daily teaching. Principal Lafontaine empathized with these teachers to calm their fears and when
teachers lost belief in their ability to master the equipment, she expressed her confidence in them as capable professionals. This support was illustrated when she said, “they [teachers] would come in very open [about being overwhelmed with technology] and we would acknowledge them [their feelings and fears] and make a list of what they had done [with technology] and see that they were learning.”

Making classroom assistance available through the buddy system required what Principal Lafontaine called “some personnel shifting,” which was not an easy task. The work assignments of the more proficient teachers and staff were revised to free the time they would need to work with other teachers. Principal Lafontaine was able to get the affected teachers to agree to these revisions in part because they knew of her strong commitment to and advocacy of technology integration. As technology integration took root, her advocacy and support was again demonstrated through her work to keep the school on the cutting edge of technology and to ensure, as she put it, “that the teachers feel like we are trying to get them the latest and the best.”

Through her advocacy of technology integration and the formal professional development Principal Lafontaine made available, the Stages of Concern and Levels of Use of all six participating teachers increased. At the end of the 2006 Summer Institute, teachers were at SoC 2 Personal, wondering how technology integration would affect them and whether it was worth the effort. However, by the third year of implementation some teacher participants had reached SoC 5 Collaboration and LoU V Integration and was collaborating with colleagues “to achieve a collective impact” (Hall & Hord, 2006, p. 160) on students.

These improvements were made possible through the hard work of the teachers and staff and the continuous support for people from Principal Lafontaine. The appreciation teachers had for the encouragement and assistance Principal Lafontaine offered was best expressed in a
comment made during the third round of interviews in the spring of 2011 by fourth grade teacher Deanna, who originally struggled with inadequacy concerns at SoC 2 Personal, but by 2011 was collaborating on PBL units and re-building her curriculum at SoC 5 Collaboration and LoU V Integration. She said, “Principal Lafontaine will give you anything that you want. She is very supportive of us.”

Support for results. The second dimension of administrative support identified in this study was support for results. As mentioned above, Blake and Mouton (1967) noted that effective leaders placed equally strong emphasis on both people and results. Principal Lafontaine recognized that she was responsible to the school governing board for technology integration, acknowledging that “I have a budget commitment and a commitment to make sure that everyone is using the technology. We can’t have it in the classroom and it not be used.” To fulfill that commitment, she made her support for results evident through four processes; clarifying her expectations for technology use, monitoring teacher participation at 2006 Summer Institute, holding the teacher review meetings discussed previously to monitor teachers’ use of technology, and managing school revenues so that funds were available for technology needs.

From the outset, Principal Lafontaine made clear to teachers that she was committed to results by clarifying her expectations about the use of technology in the classroom. Any teacher who resisted meeting these expectations was also not meeting the stipulations of the employment contract regarding technology integration. Although Principal LaFontaine offered assistance to such teachers through the buddy system or suggesting training opportunities that were available, a few teachers maintained their resistance and were dismissed from the school.

In addition attendance at the Summer Institute was mandatory and Principal Lafontaine developed a sign-off procedure for teachers to indicate that they had attended the training
required for each type of equipment. However, verifying that teachers attended the institute sessions would not ensure that teachers used technology in their classrooms. Another procedure was needed to confirm the classroom use of technology.

To reinforce her support for results, Principal Lafontaine implemented the teacher review meetings discussed previously. However, it is important to note here that these meetings were not punitive. Principal Lafontaine maintained a conversational tone, assisted teachers in reflecting on their progress in integrating the technology, and offered sources of support when support was needed. The buddy system is an example of the kind of support that grew out of these meetings. Principal LaFontaine took notes on teachers’ account of their accomplishments and challenges during the teacher review meetings. In her interview she explained that “we compile the data and share it [with faculty and staff].” These practices reinforced her support for results to the teachers. Moreover, through the teacher review meetings, she was able to stay informed about what teachers were doing and to gauge the progress being made in technology integration.

Teachers came to appreciate the opportunity to discuss technology issues with the principal at the teacher review meetings because of the help they received. Fourth Grade teacher Sally recounted her appreciation:

I think the administration has been supportive. I think the first year or two there were certainly a lot of different types of technology. It was a little overwhelming to get all of that stuff at one point. But everybody kind of chose what they were good at and what fit their teaching style best. The administration in the school listened to them and let people go with that [tools that fit their teaching style best], and they did provide ways to try to help us all out whenever they could.

The time and creativity teachers put into technology integration was an indicator of their understanding that Principal Lafontaine’s support for results was non-negotiable.
The final means by which Principal Lafontaine displayed her support for results was by managing school funds so that money was available to maintain equipment and to purchase new hardware and software. She described herself as “the money person. I help fund software, upgrade equipment, [and] provide enough money [for the latest in new technology].” Funding technology integration in these ways had a two-fold benefit; teachers were able to enhance their use of technology and, in doing so, technology integration gained an ever stronger foothold at the school.

**Summary.** The two dimensions of administrative support, support for people and support for results, were kept at the forefront by Principal Lafontaine. By placing equal emphasis on both dimensions, she opened the door to teachers’ ideas about new uses of technology. The student laptop computers and the implementation of project-based learning were changes Principal Lafontaine could not have predicted when technology integration was introduced in the summer of 2006.

**Student support.** The second form of support for technology integration was student support. Students, as digital natives (Prensky, 2001), were instrumental in facilitating the change to technology integration. They not only helped other students, but also helped the teachers learn various ways to use the technology. Four of the six teacher participants agreed that some students knew more than they did about technology. Although the participants were not specifically asked whether students contributed to their knowledge about the technology and its use, four teachers mentioned that they learned more effective ways to use the equipment from their students than they did from the formal professional development sessions they attended.

An example of the contributions students made came from the 2008 interviews. Fourth grade teacher and digital immigrant Deanna recalled that students who had experiences with the
interactive whiteboards in their third grade classroom helped her learn to use the interactive whiteboard more effectively:

The children have been helpful. They learned [how to use the interactive whiteboards] from the third grade teachers the past two years, and they came to this classroom knowing a whole lot about it. They are so smart with technology; they will be able to figure it out easier than I can. They are helping me learn things most of the time.

In the 2011 interviews, three of the six teachers commented that they also learned from the students. For example, third grade teacher and digital immigrant Maria shared that “some of them are so astute that they actually help me. I learn as much of the children and from their classes as I do from teaching or watching somebody else.” Fifth grade teacher and digital bridge Kellie had the same experience and stated that “the students know as much about it as I do. If I can't do it, they almost always can. Some of the kids have taught me how to do things.” Kellie, like Maria, found value in learning about technology from and with her students.

Based on these accounts, student contributions surface as an important factor in the change process that occurred within the school. As teachers at SoC 4 Consequence and LoU IVB Refinement (Hall & Hord, 2006) concentrated on the impact technology integration had on their students, they came to rely on the students to troubleshoot problems and suggest ideas for using the classroom technology. The contributions from the students enhanced the learning of all students and promoted the change from teacher-centered classrooms to classrooms that were increasingly student-centered.

**Time Challenges**

At the conclusion of data collection in 2011, all six teachers interviewed agreed that integrating technology had been a positive experience; however, there were also comments about challenges the teachers faced during the process. A second emergent theme that recurred in the interviews across the span of the study was the time challenges teachers faced when learning to
use the equipment and when preparing lessons that integrated technology. The teachers acknowledged that preparing and finding technology projects took a considerable amount of time. Fifth grade teacher and digital immigrant Leah shared her frustrations with time limitations.

Time constraints are something with technology because it's so much. I feel like I go home and I have to grade papers. Then, I like to lay in bed and read a book. Instead, if I get started on the computer, I could be up until one in the morning and not even know that it's one in the morning. So using technology is all about time.

Four of the six teachers agreed with Leah and acknowledged the time constraints they felt when finding technology resources for a lesson they were planning. In reflecting over the previous six years, fourth grade teacher and digital immigrant Deanna commented, “I don’t think there was anything I didn’t like except time.” Her fourth grade colleague, Sally, a digital native, confirmed that “the challenge is time, which is always a problem with teachers.” Third grade teacher and digital bridge Sheryl noted that she appreciated receiving resources from other teachers because “I just don't have time to sit down and search and research all of that.” Regardless of technology proficiency, teachers agreed that the significant amount of time it took to locate appropriate lesson ideas and resources to develop technology-based lessons was a challenge.

In addition to the time it took to develop lessons, the time required to manage technology tools, such as the student laptop computers, was noted by four of the six the teachers. Leah found that it took a considerable amount of time to get the laptop computers up and running and to address any issues that occurred at startup. She explained,

Each student in my class has a laptop, so that’s seventeen students and seventeen laptop computers. So seventeen people turn on the computers at one time and two or three will have a problem. If there is twenty-five minutes to do a lesson, it might take fifteen minutes to get them up and running. So that kind of thing is hard.
Maria also expressed this sentiment, pointing out that “about ten minutes go by before I get off and running.” She added that the “biggest challenge is that it takes time to get the laptop computers going, to get them set up, and get the students on the site or the information we need.”

Deanna concurred, commenting that “the biggest problem is not having enough time to go around and help them all.” Although many of the changes brought about by technology integration were seen as positive by the teachers, those who were less proficient with technology found that a technology-integrated environment presented challenges that were not always conducive to a productive learning environment.

Conversely, two of the participants who were more technology proficient noted that the laptop computers saved time and helped their classrooms run more efficiently. According to fourth grade teacher and digital native Sally, having laptop computers not only helped her students accomplish more and at a faster rate, but also increased student participation.

Having the laptop computers frees up a lot of time and space and issues…. I can have them all working on something at the same time instead of only three kids at a time…. We get a lot more done…. They're definitely on the computer a lot more than they were when there are only three computers in the classroom.

Similarly, fifth grade teacher and digital bridge Kellie maintained that classroom management improved due to the laptop computers and that she was better able to help her students accomplish tasks because the laptop computers were available.

I have more control and can monitor better what they are doing [on the computers]. [Because of this,] I can help them better than last year when they were spread in different places. Then, I could only see what three people were doing at a time because they were in different classrooms [using desktop computers in the other fifth grade teacher’s classroom or in a computer lab] working on desktop computers.

In summary, digital immigrants such as Maria, Deanna, and Leah found managing the technology in their classroom somewhat of a challenge because of the considerable amount of time it took to get students started on computer-based assignments. On the other hand, digital
bridges such as Kellie and digital natives such as Sally found the classroom technology saved them time in comparison to the previous arrangement for providing students access to technology. However, when it came to planning effective technology-based instruction, all teachers, regardless of digital learner classification, found it challenging to devote the time needed to locate resources.

Models of the Change Process

The results of this study led to the development of two models of the change process. The change process model, presented in Figure 4.5, expands on the model of the change process found in Figure 1.1 of Chapter 1. The Figure 4.5 includes additional information related to these change processes and summarizes the changes in teaching and learning that were discussed in this chapter.

![Figure 4.5. Change process model](image-url)
This model represents the change process described by Hall and Hord (2011) as “a process through which people and organizations move as they gradually learn, come to understand, and become skilled, and competent in the use of new ways” (p. 8). The findings of this study show that the change process was set in motion by the technology plan. Next, present in the model are the factors that originally drove the change processes. Formal professional development provided as part of those requirements gave the teachers the basic tools to begin implementing technology. Therefore, added to the model was that the formal professional development was principal-initiated because the support Principal Lafontaine provided for both people and results also drove informal JEPD, which drove informal communities of practice and informal teacher leadership to develop. These change processes facilitated technology integration which in turn led to changes in teaching and learning. The findings identified these changes in teaching and learning as extensive technology use, student-centered instruction, differentiated instruction, increased student engagement, and peer teaching. The large, curved arrows between changes in teaching and learning and formal professional development and from informal teacher leadership and changes in teaching and learning represent the reciprocal relationship between the formal and informal change processes and the changes in teaching and learning that occurred as a result. The formal and informal change processes led to changes in teaching and learning, which in turn, resulted in teachers utilizing the informal teacher-initiated change processes to implement new innovations.

However, it was the teacher-initiated change processes, specifically informal JEPD, informal communities of practice, and informal teacher leadership that facilitated technology integration and raised teachers Stages of Concern and Levels of Use (Hall & Hord, 2006). Therefore, a conceptual model was developed to relate these change processes and changes in
teaching in learning to the Stages of Concern and Levels of Use (Hall and Hord, 2006) at which they occurred. These relationships between these three factors are illustrated below in Figure 4.6.

Figure 4.6. Conceptual model

The relationships presented in the conceptual model relate the change processes and changes in teaching and learning examined in this study to the conceptual framework of the Stages of Concern and Levels of Use (Hall and Hord, 2006). The model shows that formal professional development was related to teachers’ movement from SoC 2 Personal and to SoC 3 Management and LoU III Mechanical Use. When teachers reached SoC 3 Management and LoU III Routine, informal job-embedded professional development provided during the school day by the tech team and teacher collaboration helped them to reach SoC 4 Consequence and LoU IVA
Routine. Both the formal professional development and informal JEPD were made possible by the support of the school principal. Participation in informal JEPD led to the development of informal communities of practice because teachers became concerned with student learning and reached SoC 4 Consequence and in turn teachers made efforts to refine their curriculum to best meet their students’ needs. To meet those needs, teachers at SoC 4 Consequence collaborated with colleagues and reached SoC 5 Collaboration and LoU IVB Refinement. SoC 5 Collaboration was identified as central for teachers to reach LoU IVB Refinement and LoU V Integration and also encouraged the development and participation of participants in informal communities of practice. The informal communities of practice in turn cultivated further collaboration and integration among teachers which was also fostered by the expertise of informal teacher leadership. As a result of these collaborations and informal communities of practice, teachers sustained SoC 5 Collaboration and LoU V Integration where they worked with informal teacher leaders who reached SoC 6 Refocusing and LoU VI Renewal. These interactions resulted in teachers who began to reach SoC 6 Refocusing and LoU VI Renewal themselves.

In addition to the change processes, changes in teaching and learning began to emerge as students became more engaged as teachers used technology more in their classroom and reached LoU IVA Routine. To keep students engaged, participants refined their curriculum based on the needs of students, reaching LoU IVB Refinement and began to collaborated with other teachers to continue to improve their use of technology. Subsequently, teachers reached SoC 5 Collaboration and LoU V Integration and begin extensive use of technology in their classrooms causing them to seek new ideas and resources and reach SoC 6 Refocusing and LoU VI Renewal. As a result of increased student engagement, extensive use of technology such as the
student laptops led to classrooms that were increasingly student-centered. Student centered instruction led teachers to have the ability to differentiate learning and allow students to help their peers. In turn, extensive technology use, student-centered instruction, and peer tutoring also increased student engagement.

**Summary**

The findings of the interview data were presented in this chapter through an explanation of the background of the study, findings of a priori themes and emergent themes, explanation of the change process, and presentation of a model of technology integration at the school. Examination of formal professional development showed a limited effect on the change process and changes in the teacher participants’ Stages of Concern and Levels of Use (Hall & Hord, 2006). However teacher collaboration which began as informal JEPD and developed into informal communities of practice did facilitate the change process and changed the teacher participants’ Stages of Concern and Levels of Use, and successful technology integration was achieved. Informal teacher leaders who reached SoC 6 Refocusing and LoU VI Renewal helped facilitate the integration process by providing expertise that aided fellow teachers and was recognized by the administration. Integration of technology at the school transpired as a result of these formal and informal change processes and changed teaching and learning in the school. The changes resulted in extensive use of technology, student-centered learning, differentiated learning, increased student engagement, and peer tutoring. The resulting change process also allowed for new innovations to become integrated at a faster pace than the first integration. In 2010 when student laptop computers were integrated, teachers utilized the existing JEPD and communities of practice to increase their Stages of Concern and Levels of Use regarding integration of the student laptop computers. One year later, they were already proficient enough
in these devices to begin implementing project-based learning into their curriculum. Also emergent from the study were the finding that support of the principal and students were also a driving factor in technology integration at the school. The support provided by the principal drove both formal professional development and JEPD and was central to the success of technology integration. Furthermore, emergent from the data was the finding that teachers faced many time challenges when preparing for technology integrated lessons and managing the equipment such as the student laptop computers. The findings were also developed into two models to synthesize the data. These models included a change process model and a conceptual model. Together with the models, these findings give an in depth analysis of the changes that transpired at the school over the eight year span of this study. Recommendations and implications of these findings will be further discussed in Chapter 5 of this study.
CHAPTER 5: DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

This study investigated how formal change processes and informal teacher-initiated change processes facilitated technology integration at a private elementary school in the southeastern United States. The formal change processes included various professional development formats, while the informal teacher-initiated change processes included informal job-embedded professional development (JEPD), informal communities of practice, and informal teacher leadership. In addition, the study investigated how technology integration changed teaching and learning at the school. In Chapter 5, conclusions based on the study findings are discussed. Implications for practice and future research on related topics are also presented.

Discussion

The study found evidence that formal change processes, informal teacher-initiated change processes, and a supportive principal facilitated technology integration at the school, changing teachers’ original perception of technology as an accessory to that of technology as integral to their teaching. The study also identified two unanticipated factors that, in conjunction with the formal and informal change processes and principal support, enabled the successful implementation of technology integration and other innovations as well. The first factor was understanding that “change is a process, not an event” (Hall & Hord, 2006, p. 4) and that evolves over time, expanding to include other innovations as teachers reach SoC 6 Refocusing and LoU VI Renewal. This factor was not mentioned by the teachers who were interviewed or by the principal, but was implicit in the way change unfolded at the school.

Teachers agreed to integrate technology into their teaching when they signed their employment contracts. For the first two years of technology integration implementation, no other changes were mandated. However, informal JEPD gained a foothold as teachers
collaborated to help one another improve their use of the technology. In the third year, classroom use of student laptop computers was introduced at the request of teachers, expanding the original innovation and strengthening teachers’ participation in informal JEPD. Then, in the fourth year, expansion occurred again as several teachers collaborated to use the technology as a platform for the incorporation project-based learning (PBL) in their instruction thereby shifting the focus of change to PBL. Thus, patience on the part of the principal, who understood that change was an ongoing process without a designated end point, resulted in the implementation of three innovations at the school in a four year span of time.

A second factor that contributed to successful change at the school was peer observation with feedback. First proposed by the principal to assist teachers who struggled with technology integration, teachers who saw the benefits of observing their colleagues teach began to use this strategy on their own. De-privatizing teachers’ practice through peer observation promoted greater frequency and more varied use of the technology. De-privatization of practice also helped to cement informal JEPD and to foster the development of informal communities of practice.

**Change Processes**

Technology integration was accomplished in two years, one year less than the minimum three year time frame Hall and Hord (2006) indicated is necessary for successful implementation of an innovation. Through participation in the formal and informal change processes, and with a balanced combination of support and pressure from the principal, all six teacher participants made substantial changes in their instruction, integrating interactive whiteboards, student laptop computers, and PBL into their instructional repertoire. Formal professional development and informal teacher-initiated JEPD, communities of practice, and teacher leadership were essential
to the successful implementation of all three the innovations. Collectively, these innovations had a positive impact on teaching and increased student engagement to nearly one hundred percent.

Sources of Support for Technology Integration

Job-Embedded Professional Development

In the rapidly changing technology landscape (Mishra, Koehler, & Kereluik, 2009), integrating technology into daily instruction is challenging to teachers at all experience levels. Mishra and colleagues asserted that “a new focus needs to take root, one characterized by creativity and flexibility of thought and experimentation by educators with their own educational technology designed to meet specific, immediate needs” (p. 52). To meet these immediate needs at the school, JEPD became a crucial aspect of the change process. With few exceptions, formal professional development training was less useful than JEPD. The opportunity for teachers to have in-house facilitators who modeled lessons and assisted teachers in lesson creation during the workday was another useful form of JEPD. Not surprisingly, teacher collaboration, opportunistic interactions with other teachers and technology staff members, and peer observations, were effective in helping teachers implement each innovation.

Informal Communities of Practice

Within a short span of time, teacher-initiated JEPD evolved into informal communities of practice. The communities fostered mutual trust as a norm, creating conditions in which teachers became willing to de-privatize their practice. Hall and Hord (2006) posited that “an organization does not change until the individuals within it change” (p. 7). Peer observations, ongoing discussions of new ideas, and sharing useful resources took place in the communities of practice and were an impetus for teachers to improve their use of the available technology.
Informal Teacher Leadership

The technology innovation gave the teachers that emerged as informal teacher leaders the opportunity to provide support for less skilled teachers because of their expertise. Teacher leaders provided enthusiasm for the new resources and an modeled classroom integration of technology to other teachers. These findings were consistent with the findings of Angelle and DeHart (2011) who found that elementary teachers valued their peers who spent time extra time participating in improvement activities and thought of teachers who were willing to share their expertise as informal teacher leaders. Additionally, to lessen the time challenges faced by teachers in accumulating lesson ideas and resources, these teacher leaders sent teachers links, resources, and helped teachers developed lessons to use in classes. These informal interactions were noticed by teachers and administration and some teacher leaders were moved to formal technology support positions.

Principal Support

The leadership and unwavering support provided by the principal was instrumental the success of technology integration. Ideas that she proposed set in motion teacher-initiated collaboration and JEPD which evolved into teacher-initiated informal communities of practice from which informal teacher leaders emerged. The principal also was successful in finding the funds to hire in-house support staff to provide assistance to teachers and to keep the equipment in working order. Additionally, the principal made it a point to get to know her faculty well and identify their unique talents and expertise. Consequently, she used those talents not only to support teachers who struggled with technology integration, but also to gain valued perspectives that helped her to make decisions about future innovations within the school. These actions support the claim of Pan and Franklin (2011), who suggested that administrative support is a
vital need for the implementation of technology tools into the classroom. Without effective leadership from the principal, the innovation would likely have ultimately failed. These conclusions give rise to several ways in which the findings can be applied to school practices and further research on related topics.

**Implications for Practice**

Several implications for practice can be drawn from the results of the study. The first implication is for administrators to be aware of the expertise present in their faculty and to identify informal leaders to provide support for teachers participating in a change process. Second, staff support for a technology innovation should utilize both informational technology staff and educational staff. Next, teachers who are fearful of an innovation should focus on benefits for student learning and seek out support from more proficient colleagues. Finally, because teaching and learning has drastically changed, there could be benefits in utilizing aspects of a “flipped classroom” model in schools similar to this one.

The first implication for practice is that principals who know their faculty and staff well are able to identify those informal teacher leaders with expertise to provide ongoing, in-house support for implementing an innovation. The administration in this case appeared to be aware of the unique talents within the staff and utilized these talents when they were helpful to staff members for technology integration. She very likely was also knowledgeable about their unique talents in other areas. Embedded within the faculty at this school were teachers with many years of experience and knowledge they can be shared. Administrators should also identify those faculty members who possess expertise in classroom management, subject areas, or new teaching strategies and utilize them as informal staff support.
A second implication is for administrators to consider that successful technology integration requires additional staff who can (a) fix equipment and (b) support teachers in changing their instructional practice. Preparing lessons that integrate technology is challenging and takes a considerable amount of time. Technology tools that are broken or otherwise do not work delay the start of instruction, frustrate well-trained teachers, and can become a detriment to a technology-centered school environment. These problems can be avoided by having IT staff available to fix equipment. In addition to having someone who can fix equipment, dedicated personnel should be available to provide instructional support and resources for teachers who are often overwhelmed by the time it takes to find the resources needed to implement an innovation.

In addition, an implication for teachers is that when a technology innovation is implemented, they should look past their personal fears associated with using technology and focus instead on benefits the innovation has for students. To do this, they should seek out informal support from colleagues who have expertise as a source of support and collaboration. Collaboration was integral to technology integration at the school in this study, helping teachers overcome their fears and rise to a level at which they sought out new ways to teach with technology. If a teacher is willing to collaborate, this gives them the opportunity to open up avenues for further collaboration and sharing and possibly to become an informal teacher leader themselves. However, this implication depends on the level of collegiality and collaboration that exist at the school among the teachers and their willingness to share expertise with colleagues.

A further implication of the study is related to teaching and learning. Because technology integration caused classrooms to become increasingly technology-dependent and student-centered, students took on the role of peer tutors and also made contributions to teacher
learning. As students become more responsible for their learning, teachers could consider using a “flipped classroom” (Bergmann & Sams, 2012) design for instruction.

The flipped classroom is defined as a classroom where “that which is traditionally done in class is now done at home, and that which is traditionally done as homework is now completed in class” (Bergmann & Sams, 2012, p. 13). Students access instruction by teacher-facilitated videos that students watch for homework at night while class time is used for questions, tutorials, and work that applies to what they learned the night before. The teacher’s role is similar to that of a facilitator and tutor in the students’ learning process rather than a deliverer of knowledge. Among the benefits Bergman and Sams (2012) shared concerning flipped classrooms are more teacher-to-student interactions, more student-to-student interactions, and differentiated learning. This shows that a flipped classroom, or aspects of a flipped classroom, might be a good fit for a school that has successfully integrated technology. However, it is important to note that this type of innovation might not be possible or relevant to all schools. For this to work, teachers have to be proficient users of multiple technologies and have the time to create the videos and student resources. Also, students have to have technology skills, the equipment at home that enables them to watch the video, and that equipment must be readily available for them to watch the video.

A final implication, or perhaps caution, regarding the study findings is the context in which the research was conducted. The school was small. The faculty consisted of 20 classroom teacher; the six teacher participants in the study included all teachers who taught third, fourth, or fifth grade. Successfully implementing an innovation with a small group of teachers is much easier than doing so with a medium-size or large faculty.
The school was also private. Typical of private schools in the state, teachers were employed on an annual contract, the renewal of which was at the discretion of the principal and the school governing board. Moreover, the conditions of employment written in the contract could be changed each year at the discretion of the governing board. Thus, the contract offered to teachers prior to implementation of technology integration was changed to stipulate that by signing the contract, teachers agreed to integrate technology into their instruction on a daily basis as a condition of employment. Thus, the principal and the governing board had control over who worked at the school and what the nature of their work was.

Teachers who were disinterested in using technology to teach or doubted their ability to integrate technology into their teaching were not permitted to sign the new contract and were thereby terminated as employees at the school without regard to how many years they had taught there. These circumstances meant that teachers returning to the school, such as the six study participants, had a contractual commitment to integrate technology and would be terminated at any time it was determined they were not demonstrating sufficient effort to do so. Said differently, the principal had a faculty comprised only of willing teachers; and although she was widely reported by study participants to be supportive of them and their efforts to master the technology, both she and teachers knew that the teachers’ jobs depended on successful implementation of technology integration, a leverage point not available to most principals.

These considerations limit the transferability of the study results notwithstanding the research of others that supports the effectiveness of teacher collaboration and communities of practice in bringing about change in schools. Nevertheless, the study conclusions and implications can be taken into account by administrators, school board members, and teachers
when faced with integrating an innovation such as technology. There are also recommendations for future research that can provide these stakeholders with additional insight.

**Recommendations for Future Research**

This study contributed to the body of research concerning change processes that support technology integration, particularly informal teacher-initiated change processes such as informal job-embedded professional development, informal communities of practice, and informal teacher leadership. There are several recommendations for future research.

The first recommendation is for both qualitative and mixed methods designs that explore informal teacher-initiated change processes. Currently there are few studies that focus on informal change processes or how these processes develop informally for technology integration. These processes facilitated technology integration in the study school; however, further research in a variety of school environments is needed to give additional insight into these change processes and their interconnectedness.

Research on informal teacher-initiated change processes using the CBAM model is also limited. Additional research is needed to determine if these teacher-initiated change processes move people along the Stages of Concern and the Levels of Use (Hall & Hord, 2006). Principals and change facilitators can administer the Stages of Concern questionnaire and Levels of Use questionnaire to participants when studying innovation implementation. Both instruments can be found in a book written by Hall and Hord (2006).

Longitudinal research which combines qualitative data, such as teacher interviews and observations, with data collected using the Stages of Concern and Levels of Use questionnaires would also be beneficial to administrators and technology staff to better understand how teachers experience the change process and make progress with implementation. These data have the
potential to provide information to principals and change facilitators so that they can better provide support and training to teachers involved in the change process.

A second recommendation is for investigation of digital bridges, their demographic and other characteristics, and the contributions they make to technology integration at a school. No scholarly research could be found in the literature reviewed for this study that used the term digital bridge, thus their contribution to integrating technology within a school in unknown outside of the findings of the present study. However, in this study, digital bridges were the teacher leaders who provided vital support and without the digital bridges, the integration of technology would have proceeded at a slower place. Therefore, their contributions to the change process merit further examination.

Another recommendation is for future research is investigation of student perceptions of technology integration and student learning that results from technology integration. Teachers in this study indicated an increase in student engagement when using technology and noted changes in student behavior, responsibility, and confidence when using technology. Therefore, further research could investigate student engagement and changes in these behaviors as a result of technology integration. Methods of examination of student learning could include student interviews, observations of student behavior when interacting with technology during classroom projects, and additional assessment of technology skills, grades, and test scores.

A related study might explore the ways in which technology proficient students contribute to the learning of digital immigrant teachers, including assisting teachers in using equipment such as interactive whiteboards and other technology tools. Teachers in this study noted that they learned from students and in several cases teachers commented that students knew more about certain technologies than they did. Currently research about student
contributions to teachers’ integration of technology is not present in literature. Therefore, further research into the kinds of help and support students can provide to digital immigrant teachers is merited.

Summary

The success of technology integration altered teaching and learning at the school, a claim that applies to few school change efforts (Hall & Hord, 2006). Success was made possible in this school, in part, because of the formal change processes, the informal teacher-initiated change processes, and the active support of an effective principal. However, success is also attributable to the ample time allotted for each innovation to become well-established. Insufficient time allotted to implementation, Hall and Hord (2006) cautioned, is a primary cause of the failure of change initiatives in schools. While the findings of this study cannot be transferred to other schools, lessons learned from this study can, and perhaps should, be considered by decision makers during deliberations about implementing an innovation.
REFERENCES


Angelle, P. S., & Teague, G. (2011, November). *Differences in the implementation of learning communities: An examination of the elements of collaborative work groups in two districts.* Paper presented at the annual meeting of the University Council for Educational Administration, Pittsburgh, PA. Retrieved from: [http://elps.utk.edu/Faculty_Staff/angelle.html](http://elps.utk.edu/Faculty_Staff/angelle.html).


Bergman, J., & Sams, A. (2012). *Flip Your Classroom: Reach every student in every class every day.* International Society for Technology in Education.


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APPENDIX A: PARTICIPANT PERMISSION FORM

Teacher Permission Form

Project Title: The Evolution of a whole school community of practice focused on technology integration and non-traditional instructional design: A Case Study of a Technology Rich Elementary School

Performance Site: St. James Episcopal Day School

Investigators: The following investigators are available for questions

Candace Brownfield
Instructional Technology Facilitator
(504) 296-3482
cgbrownfield@stjamesbr.org

Dr. Yiping Lou
Associate Professor, LSU/ USF
(813) 974-7886
ylo@usf.edu

Purpose of the Study: The purpose of this research is to explore the evolution of a whole school community of practice focused on technology integration and non-traditional instructional design.

Inclusion Criteria: Selected teachers and administrators and all students in grades 2-5 at St. James Episcopal Day School.

Exclusion Criteria: Students who are not in grades 2-5.

Description of the Study: Mrs. Brownfield is conducting a dissertation study for her Ph.D. in educational technology. She is seeking information concerning the process by which teachers learned to integrate technology into their classrooms. Interviews will be conducted with selected teachers and administrators, classrooms will be observed using technology, and students will complete a survey concerning their use of technology.

Benefits: Information gained from the study survey and general observations will be beneficial to St. James Episcopal Day School and the general educational community in gaining information concerning teacher collaboration, professional development, technology integration practices, and teacher leadership.

Risks: There are no known risks.

Right to Refuse: Participation is voluntary, and a child will become part of the study only if both child and parent agree to the child’s participation. At any time, either the subject may withdraw from the study or the subject’s parent may withdraw the subject from the study without penalty.

Privacy: Results of this study may be published, but no names or identifying information will be included for publication. Subject identity will remain confidential unless disclosure is required by law.

Financial Information: There is no cost for participation in the study, nor is there any compensation to the subjects for participation.

Signatures:

The study has been discussed with me and all my questions have been answered. I may direct additional questions regarding study specifics to the investigator(s). If I have any questions about subjects’ rights or other concerns, I can contact Robert C. Mathews, Chairman, Institutional review board (225)578-8692, irb@lsu.edu, www.lsu.edu/irb. I will allow my child to participate in the study described above and acknowledge the investigator’s obligation to provide me with a signed copy of this consent form.

Parent’s Signature: ___________________________ Date: ___________________________

Study Exempted By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Exemption Expires: 12-14-30
APPENDIX B: 2008 TEACHER INTERVIEW PROTOCOL

1. Can you describe your background in education?

2. What was your initial reaction to the integration of Interactive whiteboards in your classroom?

3. What do you believe is the best way to successfully learn to utilize your board?

4. How has your classroom changed since your interactive whiteboard has been installed?

5. How comfortable do you feel you are with using the interactive whiteboard?

6. How do you feel the interactive whiteboards have benefited learning in your classroom?

7. How do you feel the interactive whiteboard has affected student engagement in your classroom?

8. How do you feel the interactive whiteboard has inhibited learning in your classroom?

9. What advice would you give to someone who was thinking about or soon to receive an interactive whiteboard in their classroom?

10. What else would you like to add about the integration of Interactive whiteboards into your classroom?
APPENDIX C: 2010 TEACHER INTERVIEW PROTOCOL

1. What is your current comfort level with using technology in the classroom?

2. How did you learn how to use technology in your classroom?

3. What do you believe is the best way to successfully learn to utilize technology?

4. Describe how you have progressed in integrating technology into the classroom in the past 4 years.

5. How would you describe the support system and within your school environment?

6. How do you make plans to integrate technology into your classroom?

7. When you are faced with integrating a technology project or problem
   - Who do you ask for help?
   - How do you work through the problem
   - How do you react to the problem

8. Describe how you work with your fellow teachers to integrate technology into your classroom.

9. Describe how collaboration with colleagues affected your integration of technology within your classroom.
APPENDIX D: 2011 TEACHER INTERVIEW PROTOCOL

1. Think back to the 2006-2007 school year, when we first began to get technology, like interactive whiteboards. (pause to give the teacher time to think; prompt with suggestions if necessary)
   - What experience did you have with technology or interactive whiteboards before we got them here?
   - What do you remember about teachers’ feelings when we got interactive whiteboards? Were they excited? or did they think it was a burden? or what?
   - How did you feel about it?

2. Do you remember anyone being particularly enthusiastic about getting interactive whiteboards?
   - Who do you remember?
   - What kinds of things were they already doing with the technology in their classroom?
   - Do you remember if they helped other teachers learn to use the interactive whiteboards or did teachers pretty much learn on their own?
   - Did anyone help you learn to use any technology?
     - Who helped?
     - What kinds of things did they do that were most helpful to you?

3. One thing I’m interested in is how much teachers talked to each other about their successes and problems in using technology. Do you remember this being much of a topic of conversation?
• What kinds of things have you done to help other teachers learn to use the technology we have?
• Can you describe any ways that helping other teachers use technology helped you?
• How do you work with, plan lessons, share technology or lesson planning resources, or learn new skills utilizing other teachers and technology staff members?

4. When you think over the last 5 years and the various things we have done with technology, how supportive would you say the school has been in helping teachers integrate technology in their teaching?
• What has the principal done to help teachers increase their use of technology?
• What resources or opportunities did she provide that helped you?
• We began using peer observations and teacher review meetings several years ago. How helpful are these to you?

5. When you compare your teaching strategies now with the strategies you used 6 or 7 years ago before we got the interactive whiteboards, how would you say they have changed?

6. Can you describe how your classroom learning environment has changed because of your use of the technology we have now?

7. This year (2010-11), we started using PBL with technology integrated into the projects. Where did the idea of using PBL come from?
• In your opinion, how have teachers responded to PBL?
• What about students? How have they responded?
• When you think about student engagement, how would you say it has been affected by PBL?
• How do you think PBL has affected student learning? What have you noticed that makes you say this?

8. How much do you think teachers collaborate in developing PBL projects?
   • Can you give me some examples of what other teachers have done collaboratively?
   • What about you in particular. Can you give me some examples of ways you’ve collaborated with other teachers to develop PBL projects?

9. What do you like about the PBL projects you have been doing this year? What do you dislike?

10. Describe some of the ways you used technology in these projects.
   • What worked?
   • What did not work?
   • How did students react?
APPENDIX E: 2011 PRINCIPAL INTERVIEW PROTOCOL

1. I am doing my dissertation on how the school evolved in using and focusing on technology. According to my memory, we purchased interactive whiteboards 5 years ago, laptops 2 years ago, and implemented project based learning this year. I am curious about some of the driving forces that helped you make decisions about buying this technology.
   a. When you think back to when we first got the interactive whiteboards five years ago, do you remember how teachers felt about getting them?
   b. How did you feel about it?

2. Do you remember anyone being particularly enthusiastic about getting the interactive whiteboards? What about anyone who was frustrated?
   a. How did you utilize the teachers with expert knowledge? Why?
   b. What did you do to support the teachers who were frustrated? How effective do you think that was?
   c. One thing I’m interested in is how much teachers talked to each other about their successes and problems in using the technology. Do you remember this being much of a topic of conversation?

3. When you think over the last 5 years and the various things we have done with technology, how supportive would you say the school has been in helping teachers integrate technology in their teaching?
   a. What did you do to help teachers increase their use of technology?
   b. In your opinion, how effective have the resources your provided been? I’m thinking about things like books, conferences, and other professional development?
   c. We began using peer observations and teacher review meetings a couple of years ago
i. What were the reasons you implemented these things?

ii. Do you feel this has been successful?

4. What would you say had the most influence on your decision to purchase other technology, such as the laptops?

5. How do you feel the school has changed in the last five years since we began using the interactive whiteboards?
   a. How do you think student learning has been affected by technology integration?
   b. How do you think student engagement has been affected by technology integration?

6. Last year we began using PBL with technology integrated into the projects. Where did the idea of using PBL come from?
   - What influenced your decision to implement PBL?
   - In your opinion, how have teachers responded to PBL?
   - What about students? How have they responded?
   - When you think about student engagement, how would you say it has been affected by PBL?
   - How do you think PBL has affected student learning? What have you noticed that makes you say this?
   - To what extent would you say teachers have collaborated in developing PBL projects?
   - Can you give me some examples of what teachers have done collaboratively?

7. What do you like about the PBL projects teachers have been doing this year? What do you think needs to be changed?
   - What worked?
   - What did not work
APPENDIX F: CODING CATEGORIES

Administrative Support
Support from the school principal/administration
Blake & Mouton

Advice
Advice to other teachers who could receive boards/technology in their classrooms

Assessment
Ways that teachers use technology for student assessment

Challenges
Challenges teachers experience throughout their technology integration experiences

Changes
Teachers view how they or their classrooms have changed

Collaboration
2 teachers working together

Comfort Level
Teacher's comfort level with technology

Community of Practice
Teachers working together to learn to integrate technology, share knowledge, resources, etc. (Wenger, 1998).

Demonstration/walk throughs
Teachers gaining knowledge through watching other teachers, seeing the way other teachers teach with technology

Diffusion
How an innovation is transmitted over time

Ecology
The school environment, technology's place within it

Educational Background
The educational background/experience of teachers

Flipcharts
Teachers using Promethean Flipcharts for teaching
### Individualized Learning
Individualized learning/differentiated learning/students on their own level

### Initial Opinion
Teacher's initial reaction/opinion of technology in their classrooms

### Initial Use/Phase 1
2008 interviews

### Interactive Websites
Teachers using Interactive websites with students for teaching and learning

### Job-embedded training
Training that takes place during the normal school day in house
(Croft et al., 2010; Darling-Hammond & McLaughlin, 1995; Hannafin & Hill, 2007)

### Keyboarding
Mentions of student keyboarding skills

### Office
Projects using Microsoft office. This includes word, powerpoint, excel, etc.

### Outside Training
Training opportunities provided by sources outside the school

### Phase 2 laptops
Pertaining to use of laptops in the student 1 to 1 program

### Phase 3 project based
Pertaining to project based learning

### Professional Development
General opportunities which teachers gained technology knowledge
(Frank et al., 2011; Karmeshu, Ramen, & Nedungadi, 2012; Vanderlinde & van Braak, 2011),

### Projects
General technology projects

### Sharing websites
Teachers sharing websites to use for instruction

### Student Engagement
Student engagement when using technology

### Student Leadership
Students helping teachers learn technology or taking responsibility for their own learning
<table>
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<tr>
<th><strong>Student Learning</strong></th>
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<td>Student learning (generally)</td>
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<tr>
<th><strong>Teacher Leadership</strong></th>
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<tr>
<td>Teachers whose technology expertise helped other teachers to learn/gain knowledge of technology</td>
<td>(Angelle, 2010; Angelle &amp; DeHart, 2011; Angelle &amp; Teague, 2011; Angelle, et al., 2011).</td>
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<th><strong>Teaching Style</strong></th>
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<td>Teaching/classroom environment and the changes within it</td>
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<th><strong>Technology Staff</strong></th>
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<tr>
<td>Training/help mentioned by technology staff members</td>
<td>Broussard (2006)</td>
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<tr>
<th><strong>Trial and Error</strong></th>
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<tr>
<td>Fiddling, self teaching, etc</td>
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<th><strong>Use before school-wide Integration</strong></th>
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<td>Comments concerning the use of technology prior to school-wide integration during the 2006-2007 school year</td>
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<th><strong>Verifying/monitoring</strong></th>
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<td>Ways in which the principal verified teachers were learning to use and using technology in the classroom. Requirements for technology integration</td>
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<th><strong>Video</strong></th>
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<tr>
<td>teachers using video technology in classroom projects</td>
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<th><strong>Web 2.0</strong></th>
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<td>Teachers using web 2.0 tools such as wikis, blogs, etc for student collaboration within projects</td>
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<th><strong>Younger Teachers</strong></th>
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<td>Mentions of younger teachers helping, being hired, comments concerning their knowledge of technology</td>
<td>(Prensky, 2001; Fryer, 2006)</td>
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### APPENDIX G: THEMES

<table>
<thead>
<tr>
<th>Theme</th>
<th>a priori/emergent</th>
<th>Codes Included</th>
<th>Literature</th>
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<tbody>
<tr>
<td>Administrative Leadership</td>
<td>Emergent</td>
<td>o Administrative Support</td>
<td>Blake &amp; Mouton, 1967</td>
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<td>o Demonstration/walk throughs</td>
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<td>o verifying/monitoring</td>
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<td>o Educational Background</td>
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<td>o Initial Opinion</td>
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<td>o Use before school-wide Integration</td>
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<td>Changes in learning</td>
<td>a priori</td>
<td>o Changes</td>
<td>Hall &amp; Hord, 2006</td>
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<td>Changes in Teaching</td>
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<td>o Teaching Style</td>
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<td>a priori</td>
<td>o Advice</td>
<td>Frank, et al., 2004; Penuel, et al., 2013;</td>
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<td></td>
<td></td>
<td>o Collaboration</td>
<td>Sahin &amp; Thompson, 2006; Shapley et al., 2006;</td>
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<td>o Community of Practice</td>
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<td>o Sharing websites</td>
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<td>Formal Professional Development</td>
<td>a priori</td>
<td>o Outside Training</td>
<td>Frank et al., 2011; Karmeshu, Ramen, &amp;</td>
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<td>o Professional Development</td>
<td>Nedungadi, 2012; Vanderlinde &amp; van Braak, 2011;</td>
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<td>Job-Embedded Professional Development</td>
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<td>o Collaboration</td>
<td>Croft et al., 2010; Darling-Hammond &amp;</td>
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<td>o Job-embedded training</td>
<td>McLaughlin, 1995; Hannafin &amp; Hill, 2007</td>
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<td>o Technology Staff</td>
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<td>Teacher Leadership</td>
<td>a priori</td>
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<td>o Technology Staff</td>
<td>Angelle &amp; DeHart, 2011; Angelle &amp; Teague, 2011;</td>
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<td>o Younger Teachers</td>
<td>Angelle, et al., 2011</td>
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Based on the categories derived from the constant comparative coding process (Glaser and Strauss, 1967; Lincoln and Guba, 1985).
VITA

Candace M. Griffin completed a Bachelor of Arts degree in History with minors in English and Classical Civilizations from Louisiana State University (LSU) in 2003. She subsequently entered the Holmes program in Secondary Education and received a Masters in Education from Louisiana State University (LSU) in 2005. She entered the doctoral program in Educational Leadership and Research at LSU in Fall 2006, specializing in educational technology and is expected to graduate in December 2014. During the course of the program, she also earned her technology facilitator and technology leader endorsements.

She has worked at a private elementary school in the Baton Rouge area since 2006 as a technology teacher and facilitator. In addition to teaching technology classes to students, she maintains the school website and handles electronic communications and social media for the school. During her tenure she has been a constant presence on the school’s tech team, participated in the planning and implementation of a student one-to-one computing initiative, and provided support for teachers and administration.

Candace has also presented several times at state and national educational technology conferences. She presented with Dr. Yiping Lou at the Louisiana Association of Computer Using Educators (LACUE) conference, and has made presentations at the Southwestern Association of Episcopal Schools (SAES) Conference and at the national International Society for Technology in Education (ISTE) Conference.