A CASE STUDY EXPLORING TECHNOLOGY INTEGRATION AND INCORPORATION OF 21ST CENTURY SKILLS IN ELEMENTARY CLASSROOMS

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Abstract

As the abundance and importance of technology continues to increase, schools are attempting to stay current by utilizing technology educationally. While the technology at many schools is plentiful, few teachers are able to effectively integrate technology in their daily lessons in a meaningful way, equipping students with the 21st century skills necessary for success in later education and in society. In elementary classrooms in particular, there is a dearth of knowledge on the most effective ways to integrate technology into lessons and how to incorporate technology to teach and reinforce 21st century skills. Therefore, teachers are left without the knowledge of how to utilize technology to create successful lessons that will engage students and best prepare them for their educational careers. This study focused on exploring different methods of integrating technology and addressing 21st century skills in elementary classrooms. Online learning theory and Vygotsky’s socio-cultural theory provided a lens to explore the process through which students learn with and through technology in the current digital age. The main research questions guiding this research were: *In what ways do teachers in elementary schools integrate technology into their daily teaching?* and *In what ways do teachers in elementary schools address 21st century skills while teaching with technology?* These research questions were answered using data collected from a descriptive, embedded single-case study of the three elementary schools in a suburban school district in Central Massachusetts using teachers and teachers’ classrooms as subunits of analysis. The findings demonstrated that students were motivated by the use of technology, depending on the type of technology and the degree of participation of students. Teachers believed that technology offered many benefits to students and
teachers alike and allowed teachers to better reach more students. Teachers felt that the same methods of teaching utilized without technology apply to teaching with technology and that the activity or presentation of material in the lesson is just enhanced by technology. The findings also showed that teachers utilized technology in different ways during differing content areas depending on the type of activity, the teacher’s comfort level with the type of technology and the teacher’s comfort level with the subject area. Teachers learned about ways to utilize technology through self-teaching, collaboration, district training, and previous job positions. Lastly, the study showed that teachers had limited knowledge of 21st century skills and did not integrate these skills into daily lessons with forethought and planning through all content areas.

Keywords: technology integration, 21st century skills, instructional practices, ICT, elementary classrooms
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# Table of Contents

Chapter I: Introduction............................................................................................................. 6

Problem of Practice..................................................................................................................... 6

Significance of the Problem......................................................................................................... 9

Purpose of Study.......................................................................................................................... 11

Research Questions.................................................................................................................... 11

Theoretical Frameworks ............................................................................................................. 12

Research Design.......................................................................................................................... 12

Limitations .................................................................................................................................. 13

Document Organization .............................................................................................................. 14

Chapter II: Literature Review .................................................................................................... 15

Theoretical Frameworks ............................................................................................................. 15

Vygotsky’s socio-cultural theory.................................................................................................... 16

Online learning theory.................................................................................................................. 19

Theoretical frameworks summary................................................................................................ 22

Technology Integration .............................................................................................................. 22

Prevalence of technology in schools........................................................................................... 22

Differing effects of technology use.............................................................................................. 24

Obstacles for technology use...................................................................................................... 29

Effective Instructional Practices ................................................................................................ 31

Importance of strategy................................................................................................................. 31

Different instructional approaches for technology....................................................................... 32

Merging of technology and pedagogy ......................................................................................... 33
21st Century Skills ..................................................................................................................................... 34

Importance of 21st century skills ........................................................................................................ 35

Necessity of early introduction of 21st century skills ........................................................................ 37

Integration of technology and 21st century skills ............................................................................. 38

Literature Review Conclusion ............................................................................................................ 46

Chapter III: Research Design ............................................................................................................. 47

Research Questions .......................................................................................................................... 47

Methodology ......................................................................................................................................... 49

Approach ............................................................................................................................................... 49

Site and participants ........................................................................................................................... 51

Data collection ....................................................................................................................................... 52

Data analysis .......................................................................................................................................... 55

Validity & Credibility .......................................................................................................................... 57

Protection of Human Subjects ........................................................................................................... 59

Chapter IV: Research Findings ........................................................................................................... 62

Study Context ......................................................................................................................................... 63

Benefits of Technology ....................................................................................................................... 64

Increased student and teacher motivation and engagement ............................................................. 64

Increased relevance to students’ lives ................................................................................................. 71

Ease and accessibility of technology ................................................................................................. 72

Improved instruction ........................................................................................................................... 75

Various Uses of Technology .............................................................................................................. 81

Types of technology ........................................................................................................................... 81
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ways of learning about technology.</td>
<td>84</td>
</tr>
<tr>
<td>Strategies of teaching with technology.</td>
<td>87</td>
</tr>
<tr>
<td>Technology in differing content areas.</td>
<td>93</td>
</tr>
<tr>
<td>Incorporation of 21st Century Skills</td>
<td>97</td>
</tr>
<tr>
<td>Limited knowledge of 21st century skills.</td>
<td>97</td>
</tr>
<tr>
<td>Limited forethought and planning.</td>
<td>98</td>
</tr>
<tr>
<td>Influence of technology on 21st century skills.</td>
<td>102</td>
</tr>
<tr>
<td>Conclusion</td>
<td>104</td>
</tr>
<tr>
<td>Chapter V: Discussion of Research Findings</td>
<td>105</td>
</tr>
<tr>
<td>Benefits of Technology</td>
<td>106</td>
</tr>
<tr>
<td>Benefits for students.</td>
<td>106</td>
</tr>
<tr>
<td>Benefits for teachers.</td>
<td>110</td>
</tr>
<tr>
<td>Prevalence of Technology</td>
<td>111</td>
</tr>
<tr>
<td>Similar Teaching Strategies With and Without Technology</td>
<td>111</td>
</tr>
<tr>
<td>Importance of updating teaching strategies to reflect digital age.</td>
<td>112</td>
</tr>
<tr>
<td>Technology use in different content areas.</td>
<td>114</td>
</tr>
<tr>
<td>Basic Incorporation of 21st Century Skills</td>
<td>114</td>
</tr>
<tr>
<td>Balancing content and incorporation of 21st century skills.</td>
<td>116</td>
</tr>
<tr>
<td>Increased Collaboration, Communication, and Active Learning</td>
<td>118</td>
</tr>
<tr>
<td>Collaboration and communication.</td>
<td>118</td>
</tr>
<tr>
<td>Active learning</td>
<td>119</td>
</tr>
<tr>
<td>Summary of Findings</td>
<td>119</td>
</tr>
<tr>
<td>Delimitations and Limitations of the Study</td>
<td>120</td>
</tr>
</tbody>
</table>
Chapter I: Introduction

Problem of Practice

In the profession of teaching, technology has the potential to transform teaching and learning for students; however, many schools do not take full advantage of or are unaware of the many opportunities to improve teaching and learning through effective technology integration. The majority of elementary teachers is uninformed of effective ways to integrate technology and how to incorporate 21st century skills into lessons with technology, resulting in many elementary teachers utilizing technology haphazardly without any direction on how to successfully incorporate technology into daily lessons (Ally, 2008).

In the 2007-2008 school year, the average school district in Massachusetts spent $212 per student on materials related to technology (Massachusetts Department of Elementary and Secondary Education, 2009). Even with huge investments in monetary funds, technology still remains underutilized in many classrooms. In Massachusetts, 53% of teachers utilize technology on a daily basis in their classrooms (Massachusetts Department of Elementary and Secondary Education, 2011b). Among the teachers who consistently integrate technology into lessons, few do so effectively. According to results from the Technology Self-Assessment Tool (TSAT) from the Massachusetts Department of Education, only 11.1% of teachers are considered “advanced” with technology and 15.2% categorized as “proficient” (Massachusetts Department of Elementary and Secondary Education, 2009). Without sufficient proficiency with technology, teachers are unable to integrate technology utilizing proven effective methods, therefore, not significantly impacting the academic achievement of students and not adequately
preparing students for their futures (Groff & Mouza, 2008). For a complete list of technology abbreviations, see Appendix A.

Furthermore, in order to score in the “advanced” range of the TSAT, teachers must incorporate technology with higher level thinking skills, such as 21st century skills. Only 11.1% of teachers achieved this level of integration, demonstrating that the majority of teachers in Massachusetts is not consistently incorporating 21st century skills with technology (Massachusetts Department of Elementary and Secondary Education, 2009). A deeper understanding of instructional practices to utilize with technology integration and methods on how to address 21st century skills in lessons with technology is necessary in order to improve the quality and use of technology in the classroom.

The underutilization of technology is evident throughout the country. In a study of five low resource schools and one high resource school in California, all five low resource schools utilized technology for primarily low skill level activities that emphasized drill and practice routines (Valadez & Duran, 2007). In addition to the presence of technology, effective instructional practices with technology that focus on higher-level skills are also essential. Twenty-first century skills encompass higher-level thinking, as critical thinking, problem solving, creativity and innovation, and collaboration all require that students be engaged in higher order thinking. Therefore, in order to utilize technology in a way that significantly impacts students’ achievement and preparation for later schooling, it is necessary for educators to be aware of best practices in technology integration, including how to incorporate 21st century skills into lessons.

The same issue that is evident in numerous schools throughout the country is also apparent in the three elementary schools in a school district in Central Massachusetts. In
this district, few elementary educators were seen utilizing effective technology integration in elementary classrooms. For this study, effective methods of technology integration included methods of utilizing technology during teaching that engage and motivate students and teachers, allow all types of learners to participate, increase student learning, and require higher level thinking skills through incorporation of 21st century skills. Twenty-first century skills will be defined as problem solving and critical thinking, collaboration and communication, and innovation and creativity. All of these skills are essential, in conjunction with technology and core subjects, for students to be successful in current and future complex work environments (Partnership for 21st Century Skills, 2009). Technology can provide an avenue to higher-level learning and can prepare students with 21st century skills such as problem solving skills, communication skills, and critical thinking (Massachusetts Department of Elementary & Secondary Education, 2008).

While technology, such as interactive whiteboards, computers, projectors, wikis, blogs, digital cameras, and iPads, is available in this school district in Central Massachusetts, most teachers use the technology infrequently. When technology is used, it is most commonly used for lower level thinking processes, such as using reading software and practicing math facts, rarely integrating higher-level skills such as 21st century skills into lessons. Many teachers do not seem to utilize technology in creative and effective ways in the classroom. Since this school district is representative of the issue of ineffective technology integration that is plaguing many of the nation’s schools, it was chosen as the subject of this research.
Furthermore, elementary classrooms were chosen as the subject of this study because of the lack of research on how to utilize technology in elementary classrooms. Elementary students are substantially different from middle school and high school students because of their lack of proficiency with reading and technology, therefore affecting the appropriateness of many types of technology and methods of technology integration that are widespread in middle and high schools. While effective technology integration strives to achieve the same objectives at all ages, the ways through which teachers utilize technology to motivate and engage students, increase student learning, reach all different types of learners, and integrate higher order thinking through incorporation of 21st century skills can be vastly different depending on the student’s age.

Significance of the Problem

The majority of teachers throughout all grade levels, not just in Massachusetts but also across the nation, do not consistently employ effective methods of technology integration (Harris & Koehler, 2009; Massachusetts Department of Elementary & Secondary Education, 2011). Besides limiting students’ ability to develop essential 21st century skills and increase students’ learning, a lack of effective technology use in the classroom also threatens to disengage the student population. In a report by the U.S. Department of Education, students felt strongly about the importance of technology in the classroom and stated technology was an “essential and preferred component” of their lives because they believed in the positive value of technology (U.S. Department of Education, 2004). Without increasing the effectiveness of technology integration in schools, teachers will miss out on valuable opportunities to engage and motivate students.
Additionally, incorporating technology in a way that integrates higher-level thinking should become a vital component of schools in order to prepare students to be competitive in the job market and to become lifelong learners. Empowering students with 21st century skills will enable students to be more successful in the current digital age. According to the U.S. Department of Education, 49% of students are interested in pursuing a career in technology (U.S. Department of Education, 2008). Additionally, in a span of just 16 years, from 2000-2016, jobs in technology will increase by 24% (SETDA, 2008). However, almost one quarter (24.4%) of students in the United States do not reach the baseline level of scientific achievement, the level of achievement necessary for using science and technology in authentic life situations and less than one half of students reach the baseline for problem solving, the level necessary to meet current work demands (Alliance for Excellent Education, 2008). As the world becomes increasingly more globalized, technological prowess will become progressively more important, as the number of jobs requiring technology and 21st century skills increases (SETDA, 2008).

Technology is one of the key aspects of an increasingly important field entitled STEM (science, technology, engineering, and math). Currently, there are few students interested and qualified to enter into the rising number of STEM jobs. In order to improve the quantity and quality of students in the STEM pipeline, schools need to provide students with engaging STEM lessons at an early age to excite students about STEM careers and also prepare teachers with adequate training to allow all students to reach a baseline level of proficiency in STEM subjects and 21st century skills (Governor’s STEM Advisory Council, 2010). For elementary students, engaging in successful and effective classroom activities centered on technology incorporating 21st
century skills will allow students to be successful in secondary education and in the workforce. Furthermore, increasing the amount of exposure to technology, 21st century skills, and STEM subjects in general will encourage more students to pursue academic paths and jobs centered on these subjects.

**Purpose of Study**

This study described the different strategies that elementary teachers utilized to integrate technology into their classroom and how they addressed 21st century skills during lessons with technology. Interviews and observations of elementary teachers currently integrating technology frequently in the classroom were conducted in order to describe how teachers and students utilize technology in the classroom to teach and learn, how teachers integrated technology throughout lessons, what methods the teachers employed when teaching with technology, and how teachers incorporated 21st century skills during lessons with technology. Together, all of these aspects, along with background information provided by the Technology Director, provided a holistic picture of how technology is being utilized on a daily basis during lessons. The comprehensive picture of technology use and incorporation of 21st century skills enabled specific recommendations to be developed to further improve the use of technology in the elementary classroom to ensure students are receiving full academic benefit from the technology and are being adequately prepared for their later education and life in society.

**Research Questions**

In order to describe the ways that teachers integrated technology into daily lessons and used 21st century skills, the following primary research questions were explored: (1) *In what ways do teachers in elementary schools in a suburban school district in Central*
Massachusetts integrate technology into their daily teaching? (2) In what ways do teachers in elementary schools in a suburban school district in Central Massachusetts address 21st century skills while teaching with technology?

**Theoretical Frameworks**

Both Vygotsky’s socio-cultural theory and online learning theory were utilized as a lens to explore technology integration and use of 21st century skills in lessons with technology in the context of an elementary classroom. Vygotsky’s socio-cultural theory places importance on the context of the classroom and the process by which students learn, including a large emphasis on participation and interaction between teachers and students and students with each other (Vygotsky, 1978). Online learning theory explores the differences between traditional, teacher directed learning and learning with and through technology and how instructional practices need to be updated to reflect the digital age. The purpose of this study was to describe the ways that technology was utilized in daily lessons, including focusing on the degree of participation of students, the amount of interaction between students and their teacher and students and peers, and the context of the classroom, while also exploring the ways that lessons with technology were similar and/or updated from traditional lessons.

**Research Design**

The goal of this study was to explore the ways that teachers integrated technology into daily lessons and how teachers addressed 21st century skills during lessons with technology. The embedded, single-case study enabled the development of thick descriptions that depicted how technology was utilized in classrooms and how 21st century skills were incorporated, while also portraying the context of the elementary
classroom. Through a case study design, a comprehensive and holistic picture of technology integration and incorporation of 21st century skills was described.

**Limitations**

This study explored technology integration in six elementary classrooms in a single district. Since the study only described technology integration in the elementary schools in one district, generalization to other school districts and to middle schools and high schools is limited, as differences in availability of technology, professional development in teaching with technology, age of the students and other demographic differences of the teachers and students vary between school districts and can greatly impact how teachers use technology.

There are also limitations in interviews and observations. To account for this limitation, teachers were ensured they would remain anonymous at all times, interview questions were clarified and explained, multiple observations were conducted to corroborate data, and member checking was utilized with participants to confirm that their ideas were accurately captured.

Furthermore, the researcher is also a teacher at one of the elementary schools involved in the study. Being a colleague of the teacher participants and a known teacher to the students in the classrooms studied could have been a potential source of bias. To minimize the inherent bias, specific protocols were utilized for interviews and observations to increase consistently between all interviews regardless of the relationship between the researcher and the participants and also to increase consistency between the observations and what the researcher looked for and observed during lesson observations. Furthermore, bias was limited by describing all aspects of technology integration as fully
and accurately as possible. Peer debriefing was also utilized, so colleagues could read and assess whether the findings were plausible.

**Document Organization**

This study is divided into five main sections. First, the background and significance of the problem, a summary of the research questions, and the main theoretical frameworks utilized to frame the study were outlined. Next, the theoretical frameworks utilized to frame this study will be described, along with summary of the current research related to technology integration in the elementary classroom, including a look at the benefits of technology integration, the obstacles to technology integration, the diverse methods of incorporating technology, and a close look at 21st century skills. In the following section, the research design will be described, including the methodology, data collection and data analysis for the study, along with how issues of validity and reliability were attended to. Finally, this study includes a section discussing the results of the study and recommendations for further study.
Chapter II: Literature Review

In recent years, technology has become increasingly common and more plentiful in most schools (Gray, Lewis, & Tice, 2009). Schools are scrambling to remain current in the digital age by increasing the amount of technology present in education and updating lessons to better prepare students for the evolving world. To glean the benefits from technology, such as increased student learning, improved student motivation and engagement, greater success of diverse learners, and greater preparedness for the digital world, teachers must do more than simply incorporate technology (Chang, Hsieh, Ou, Tarng, & Yu, 2012; Judson, 2010; Montminy, 2009; Swartz, Balkin, & Phillips, 2003). Teachers must effectively utilize technology by emphasizing higher-level thinking skills through addressing and reinforcing 21st century skills during lessons (Valadez & Duran, 2007). By integrating technology and 21st century skills, teachers introduce content in a way that is more authentic, more engaging and motivating, and will better prepare students for later education and their future lives in society (Dede, 2007). Examining the literature related to technology integration and the use of 21st century skills in schools will more accurately explain the potential benefits of technology integration, will more clearly define effective instructional practices to utilize with technology integration, and will examine the ways that 21st century skills can be addressed through the use of technology.

Theoretical Frameworks

To develop an understanding of technology integration and the use of 21st century skills in elementary classrooms, two theoretical frameworks were utilized. First, Vygotsky’s socio-cultural theory was explored in order to examine how the context of the
classroom influences technology integration. This theory was utilized to understand the importance of technology as a cultural tool and to examine and describe ways of skillfully utilizing this tool and incorporating of 21st century skills in order to positively impact students’ future lives in society (Miller, 2011). Secondly, online learning theory was used to provide information on technology and to investigate different ways to integrate technology into the classroom. Through online learning theory, connectivism, a learning theory for teaching with and through technology, will also be examined as it provides information on the differences between traditional instructional practices in the classroom and how technology has changed or updated these practices (Ally, 2008).

Both online learning theory and socio-cultural theory emphasize the importance of students learning in authentic ways that emulate the outside world. The theories encourage methods of learning that address 21st century skills by incorporating communication and collaboration, problem solving and critical thinking, and creativity and innovation (Ally, 2008; Miller, 2011).

**Vygotsky’s socio-cultural theory.**

The first component that facilitated an understanding of technology integration in an elementary classroom was Vygotsky’s socio-cultural theory. Utilizing technology while teaching can transform the context of the classroom, depending on the methods teachers employ to teach with technology. There were a variety of practices investigated in this research; some practices that altered the context of the classroom more so than others. Through Vygotsky’s socio-cultural theory, the context of the classroom and how the context contributed to, detracted from, or did not affect student learning was explored.
Vygotsky’s socio-cultural approach emphasizes the importance of active learning and students co-constructing knowledge. The process of knowledge construction is much more important than the product in this theory (Vygotsky, 1978). By engaging in activities and focusing on the process of learning instead of the product, students are able to gain a deeper understanding of the content, which facilitates the process of students making connections between prior knowledge and new information (Miller, 2011). Some methods of technology integration rely much more heavily on student participation and construction of information. When technology is introduced merely in order to show students an aspect of content, the process of student learning is minimized compared to the product of learning, with students rarely engaging in opportunities to construct their own knowledge. On the other hand, when technology is incorporated throughout the lesson, with students learning through technology, the learning in the classroom significantly changes, as the process of learning is greatly emphasized, a key aspect of Vygotsky’s theory (Vygotsky, 1978). This aspect of Vygotsky’s socio-cultural approach will inform the learning process and how students most effectively construct new information.

Additionally, Vygotsky’s socio-cultural approach highlights the student’s cultural context, including the social settings, physical settings and objects, such as technology. Tools, like technology, are devices embedded with society’s ideas and skills. Learning develops specific abilities. In order to improve one’s performance in an area, there needs to be similar elements between that area and what a student has learned, therefore, necessitating the use of authentic activities in school to increase transfer of student skills (Vygotsky, 1978). By utilizing these tools in authentic activities, students become more
capable of contributing to and participating in the larger society (Miller, 2011). Much of the push for technology integration in schools hinges on the idea that technology integration makes learning more authentic. Technology abounds daily life for most people and is a significant component of success in the workforce. Therefore, utilizing technology while teaching and during student learning will allow students to participate and learn new information in ways similar to how they will be asked to utilize the information when they enter the workforce. Students must be exposed to similar situations in school that they will face in society in order to be fully prepared to be successful (Dede, 2007).

Furthermore, Vygotsky’s socio-cultural approach stresses the importance of stretching students’ minds beyond their potential capabilities through working in a students’ zone of proximal development (ZPD) with a more knowledgeable other (MKO), either a peer more knowledgeable in a subject or the teacher (Vygotsky, 1978). Technology can potentially act as a MKO, as certain ways of utilizing technology can direct students through learning, with the technology acting as a guide. From this collaboration, students are able to reach a higher level of achievement (Vygotsky, 1978). Understanding how collaboration and teacher, peer, or technology support can influence learning will inform the study on how to best utilize technology in a way that facilitates engaging a student’s ZPD and making use of MKOs.

Learning from and with peers, thus capitalizing on a student’s ZPD and the use of MKOs, is also directly related to 21st century skills. Twenty-first century skills (problem solving and critical thinking, collaboration and communication, and innovation and creativity), all rely on the ability to work with peers. In order to strengthen these skills
and to prepare for the workforce, students must frequently practice utilizing 21st century skills (Partnership for 21st Century Skills, 2009). Utilizing 21st century skills such as problem solving often requires that students collaborate with others and work in their ZPD. Understanding Vygotsky’s theory on technology as a cultural tool and relating this idea to students’ future lives in society will allow for a deeper understanding of how 21st century skills can be utilized in conjunction with technology to prepare students for their educational careers. Exploring different strategies to integrate technology in the classroom and the extent to which different strategies utilize peers as a resource will also further the understanding of the effectiveness of technology integration.

Vygotsky’s socio-cultural theory was utilized as a lens through which to examine and explore the ways that teachers use technology and incorporate 21st century skills into lessons. This theory facilitated understandings about the context of the classroom, the use of peers, and the significance of the context to students’ future lives. However, in order to better understand technology integration and how instructional practices have been directly impacted by technology, it was imperative to investigate online learning theory and how this theory can provide a framework for how to actually use technology.

**Online learning theory.**

Online learning theory furthered an understanding of technology integration in the classroom by providing insight on how to implement instructional practices that motivate and engage students, provide students with higher-level learning opportunities, prepare students for the digital age, and allow diverse students to succeed with current technology. Many features of online theory complement Vygotsky’s socio-cultural perspective, while expanding on the ideas relative to the online learning age. An
essential component of online learning theory focuses on how instructional strategies can be modified in order to incorporate technology. Many strategies used with technology are not novel; they are simply adapted from current practices in the classroom, with the computer or other type of technology as the instrument assisting in instruction (Ally, 2008). Online theory utilizes ideas from many previous theories central to education, such as constructivism, behaviorism, and cognitivism (Dede, 2007). However, online learning theory also is founded on the connectivist tradition, taking into account the changing learning environments and the increasingly global world (Ally, 2008).

Connectivism embodies many principles helpful in understanding how to use technology successfully in the classroom. In 2004, connectivism was presented as a new theory of learning (Siemens & Canole, 2011). There is still debate over the exact classification of connectivism, whether it is actually a theory or rather an instructional practice (Kop & Hill, 2008). Even though the debate continues, information gleaned from connectivism is essential in furthering a deeper understanding of online learning theory. In contrast to many previous approaches, connectivism emphasizes the dynamic aspect of learning. Technology has increased the rate at which new information is discovered and shared, necessitating that students are able to engage in deeper level thought processes with new information. Students must now be able to know how to get information, how to verify its accuracy, how to collaborate with others with this information, how to share information, and how to problem solve with it (Ally, 2008). Information changes so rapidly that students must participate in this deeper cycle of learning on a daily basis.
As a result of this differing dynamic, many researchers argue that teaching with and through technology should be approached in a different way than traditional teaching. Teaching practices should be altered and updated to reflect constantly changing information and need to focus on how to teach students to keep abreast of new and changing information. Students need to learn how to learn, rather than simply learning already present information. Practices incorporating 21st century skills can increase a student’s ability to problem solve and use critical thinking to keep up with the changing pace of information. For example, with project-based learning, one strategy that can be utilized to incorporate technology, students have to investigate an authentic problem by finding information, applying critical thinking skills to verify the accuracy and impact of the new information, and utilizing problem-solving skills to determine how to use this information to solve their problem. Online learning theory, while relying on some principles of other theories, outlines different aspects of learning which are more uniquely adapted to the intricacies of technology (Ally, 2008).

The role of the changing world is also a key aspect in online learning theory. Many jobs previously completed by people are progressively being reallocated to machines, necessitating a change in educational preparation. In online learning theory, the role of 21st century skills are examined and learning practices are derived based upon the future needs of the world. Teaching practices must evolve in order to parallel the changing conditions of the workforce and society in general. Thus, instructional practices should not be stagnant, and, instead, must adapt to mirror society, better preparing students for society (Dede, 2007). This aspect of the theory enabled closer
examination of how teachers were utilizing technology in the classroom and incorporating 21\textsuperscript{st} century skills to better prepare students for the changing world.

\textbf{Theoretical frameworks summary.}

Both online learning theory and Vygotsky’s socio-cultural approach facilitated the investigation of how technology can be effectively integrated into schools in order to improve students’ academic achievement and overall technological prowess, while also increasing students’ use of 21\textsuperscript{st} century skills, helping them to thrive in later schooling and society. The two complementary theories address how students learn and explore vital instructional strategies necessary to improve students’ proficiency. Together, the theories helped to build a comprehensive picture of not only the learning process of students, but also how technology can be integrated successfully to produce strong learning outcomes. This information was necessary in order to evaluate this problem of practice and assess effective technology integration.

\textbf{Technology Integration}

\textbf{Prevalence of technology in schools.}

Many schools in Massachusetts and across the country are spending vast amounts of money to increase the amount of technology in schools. The United States, over the past 10 years, has spent 66 billion dollars on funds allocated to technology in education (Lei, 2010). The increase of technology has been widespread throughout the nation, with 100\% of public schools in the United States now connected to the Internet (Gray, Lewis, \& Tice, 2009).

Along with an increase in the quantity of technology present in school, the types of technology in schools have also become more diverse. While reference to the amount
of technology in schools was traditionally used to simply account for the number of computers a school had, schools now utilize many different types of technology for diverse purposes. Among the different kinds of technology available are computers, interactive whiteboards, iPads, cell phones, digital document cameras, the Internet and the websites accessible through the Internet, and computer software programs.

Along with increasing the quantity and breadth of technology throughout the United States, schools are also ensuring that technology becomes a curricular priority for teachers and students alike. Educational technology topics have become a highlighted area for teacher professional development, with 95% of schools having offered professional development related to technology integration in the classroom. Furthermore, 88% of teachers throughout the United States agree that technology is a priority and 83% of teachers are interested in learning about technology (Educational Technology in Public School Districts, 2008). Interest in technology has drastically increased in recent years, with many funds being allocated to technology and a majority of teachers becoming interested about technology use in the classroom.

With an increase in technology and technological resources, many more teachers are integrating technology on a more frequent basis. In 2010 in Massachusetts, 81% of teachers utilized technology while teaching at least once a week, with 53% of teachers utilizing technology on a daily basis. In just one year, this shows a 3% increase in the amount of teachers utilizing technology while teaching at least once a week, and a 3% increase in the number of teachers utilizing technology on a daily basis (Massachusetts Department of Elementary and Secondary Education, 2011b). With the increase in quantity of technology, interest in technology, and use of technology, it is now imperative
that school districts investigate how teachers should utilize this technology in order to best support student learning.

**Differing effects of technology use.**

The impact of this increased abundance and use of technology has been varied. While some researchers have reported widespread academic gains for students in classrooms utilizing technology, other researchers have observed far less success with technology.

**Potential benefits of technology.** Some studies have highlighted the potential benefits of technology on not only students’ academic achievement, but also on students’ engagement with learning and decreases in problematic behaviors among students.

Student engagement in the classroom consists of students exhibiting behaviors important for learning, demonstrating social behaviors that contribute to learning, and not participating in activities that take away from learning (Finn & Pannozzo, 2004). Student engagement is malleable, and, by increasing student engagement, students’ academic outcomes can be positively affected (Finn & Rock, 1997).

Some researchers argue that technology use in the classroom can increase the academic achievement of students by providing an alternative method for students to more effectively learn classroom information and achieve state standards. In a study of 3rd to 6th grade classes in a Montessori School, Montminy (1999) found that utilizing technology allowed students to review the same content material as a teacher directed lesson in a different way, providing students with further examples of a concept. Having this expanded knowledge and additional examples of a concept facilitated concept development in students, promoting greater generalization (Montminy, 1999). In another
study, Chang et al., (2012) concluded that use of virtual learning enhanced student learning and motivation when compared to traditional instruction. Student motivation in education is comprised of a student’s beliefs about his/her own competence and ability to complete schoolwork and a student’s desire to want to do schoolwork and his/her rationale for demonstrating competence (Ryan, 2000).

Technology integration has also been suggested to close the gap between students who are struggling and their grade level peers, by providing more ways for teachers to differentiate more precise support and build upon students’ strengths and weaknesses (Judson, 2010). In a study of at-risk students in language arts and mathematics, a technology based learning intervention had a greater effect on students’ mean academic achievement as compared to a traditional instructional intervention (Neill & Mathews, 2009). Technology can function as a diagnostic tool, allowing teachers to monitor and more closely target students’ areas of strengths and weaknesses. As students utilize different types of software, the software can track how well students do on different skills and different levels of skill tasks. This analysis can provide information to teachers about where students are struggling, thus allowing teachers to further target these skills with students. Diagnostic tools allow teachers to see which information students have mastered and which information teachers need to provide further instruction on. In a study comparing two schools utilizing the same software program, the teachers at the school with higher gains in academic achievement among students utilized information from students’ performance with the software to modify instruction. The teachers used information from the software to review confusing vocabulary terms and target additional
areas for instruction, with the diagnostic tool facilitating greater gains in academic achievement for students (Means, 2008).

Moreover, technology allows teachers more time to support struggling students, as students can eventually become more independent when certain types of technology are utilized. In a study with 11 urban high-risk first grade classrooms, students became more independent during writing when literacy software was used, allowing teachers more undivided time for small group instruction. Teachers were able accomplish more during this small group instruction, as there were fewer interruptions from other students (Blachowicz, Bates, & Berne, 2009). Students are often more apt and able to help other students when using technology as their comfort level with technology is often greater than the teachers’ comfort level, increasing the degree of collaboration in the classroom and decreasing a need for teachers to help with instructional tasks and instead focus on clarifying content information for students (More-Hart, 2008).

Additionally, technology also can allow students with diverse learning needs who have difficulty in a traditional classroom to excel. In a case study of best practices in using computer multimedia at a middle school, Swartz, Balkin & Phillips (2003) contended that students who might not succeed in a traditional classroom often perform much better while using technology. In this study, the use of computer multimedia increased the quality of work of all students, but more unexpectedly, low performing students performed just as well as high performing students when using technology. With technology, different skills are highlighted and diverse interests tapped into, often allowing students who might have more difficulty in a traditional classroom to excel.
Furthermore, technology integration can improve students’ academic achievement because students are more engaged and motivated, which often results in students becoming self-regulated learners who have greater use of metacognitive skills (Chandra & Lloyd, 2008; Ching, Want, Shih, & Kedem, 2006). In a case study of 21 kindergarten and first grade students, researchers observed that students working with digital photography in creating journals became more engaged in their work when digital cameras were utilized (Ching et al., 2006). Many teachers and students are enthusiastic about the use of technology increasing students’ motivation towards learning, improving students’ beliefs in their own abilities and increasing students’ desire to demonstrate their abilities (Ryan, 2000). In a case study of 11 first grade classrooms with teachers utilizing technology during literacy, both teachers and students reported, through interviews, being more engaged and excited by teaching and learning (Blachowicz, Bates, & Berne, 2009). Another study comparing two groups of tenth grade students, one group in a traditional science class and another in an e-learning cohort, showed increased student engagement of students in the e-learning cohort. Increasing students’ level of engagement also increased students’ metacognition, as students in the e-learning cohort became more actively involved in the lesson and gained more control over their own learning (Chandra & Lloyd, 2008). Writing utilizing technology can also increase engagement and interest as it provides a direct link to many students’ interests, including e-mailing, text messaging, and blogging. In a study of middle school students participating in a Multi-User Virtual Environment (MUVE), students were able to utilize blogging, e-mailing, and text messaging to solve problems. In this study, employing technology to increase students’ interest and engagement with writing caused students to practice more
frequently and lead to students becoming better writers (Warren, Dondlinger, & Barab, 2008).

Many researchers have documented the numerous potential benefits of technology use in the classroom (Blachowicz et al., 2009; Ching et al., 2006; Judson, 2010; Neill & Mathews, 2009; Warren, Dondlinger, & Barab, 2008). However, while the potential benefits of technology are vast, simply introducing technology into the classroom does not necessarily predict success for all students and schools (Chandra & Lloyd, 2008; Means, 2010).

**Disparate results of technology.** Other studies have found technology to be beneficial for some, but not for all. In some instances, students’ academic achievement has been improved through technology use, but the improvement has been limited to certain students or classes. According to a recent study by Chandra & Lloyd (2008), where the same software was implemented in two different schools, gains in achievement through technology integration were disparate across groups of students, depending on whether the teacher utilized information from the software to modify instruction. Students in classrooms where information from the software drove future classroom instruction reported greater gains than in classrooms where the information from the software was not utilized. Depending on the quality of the implementation of technology into schools and the characteristics of the schools, contrasting effects of the same computer software or type of technology are often seen in different schools (Means, 2010). Factors such as how the technology is used and the quality of the technology can create differing impacts of technology integration in the classroom, potentially causing the benefits of technology use to not be widespread throughout a class or school.
The occasionally dissimilar results of technology integration have left many wondering whether the uneven benefits of technology use are attributed to the quality of technology or the strategies of technology instruction in the classroom. The lingering question of whether technology use can be better quantified through frequency of use or by strategy of use has been the subject of much research. Some researchers argue that quantity of technology and the amount of technology use alone does not predict potential benefits. The strategy of technology use must be effective in order for students to experience the benefits of increased achievement as a result of technology (Groff & Mouza, 2008; Lei, 2010).

**Obstacles for technology use.**

The surrounding questions of technology use in the classroom have created obstacles to technology integration for many teachers. To integrate technology into the classroom is not simply just to use technology in any fashion. Instead, teachers not only need to be cognizant of learning about and using technology, but also about the methods with which to utilize technology and the most appropriate type of technology for their purposes. Technology itself does not guarantee results for teachers and might even potentially hinder students’ achievement (Lei, 2010). Therefore, information regarding how to utilize technology in the context of a classroom is essential, instead of just focusing on how to operate technology.

In Massachusetts, the majority of teachers is unaware and unable to utilize technology in an advanced way in the classroom. According to results from the Technology Self-Assessment Tool (TSAT) submitted from 59% of Massachusetts’ school districts to the Massachusetts Department of Education, only 11.1 % of teachers
are considered “advanced” with technology and an additional 15.2% are categorized as “proficient” (Massachusetts Department of Elementary and Secondary Education, 2009). In order to demonstrate successful technology integration, teachers need to feel comfortable utilizing technology (Groff & Mouza, 2008). However, as results from the Massachusetts TSAT show, most teachers are not comfortable utilizing technology.

Furthermore, the school environment and physical environment can discourage teachers from integrating technology into their daily lessons. Numerous demands such as increased pressure of student performance, abundant state standards, and insufficient time leaves many teachers feeling overwhelmed. Additionally, district and statewide assessments require much time, resulting in many teachers feeling as if they are without sufficient time to explore and implement technology into the classroom (Qablan, Abuloum, & Abu Al-Ruz, 2009). The physical environment can also constrain teachers, as many schools were constructed before the influx of technology.

Currently, a minority of teachers effectively integrates technology into the classroom, therefore not fully realizing the potential benefits of technology use. Without knowledge of effective instructional strategies and without proficiency with different types of technology, teachers cannot expect to improve classroom instruction through technology. In order to inform this study targeted at exploring the different ways that teachers utilize technology and incorporate 21st century skills into the classroom, the second body of literature on effective instructional practices is necessary to inform the strategy of technology integration.
Effective Instructional Practices

**Importance of strategy.**

The presence of technology does not always translate into successful technology integration. In fact, the quantity of technology in a classroom is not usually linked to gains in student achievement (Lei, 2010). However, the way technology is used is significantly associated to positive outcomes in students (Lei, 2010). In a study of 237 seventh and eighth graders in a technology rich school in the Northwest United States, the amount of technology did not have an effect on students’ academic achievement. However, when comparing the different strategies of technology use, the quality of technology use by teachers did have an effect on students’ achievement (Lei, 2010).

Sound instructional design is essential when incorporating technology. In a study of preschools, kindergartens, and secondary schools in the Silicon Valley, Cuban (2001) found little effect of technology on students’ achievement when it was used mainly for administrative purposes and low skill activities. In another study, Padron, Waxman, Lee, Lin, & Michko (2012) discovered that many teachers’ technology use was primarily limited to direct instruction and didactic teaching. When technology is not fully integrated into lessons and is utilized for administrative purposes and lower level thinking, technology does not always provide benefits for students (Kurt, 2010).

Utilizing technology as a vehicle for instruction will not significantly change the method of instruction or facilitate student learning (Tearle, 2003). Technology is not a method, but simply the tool delivering instruction to students (Ally, 2008). Teachers must recognize it is not enough just to use technology; technology must be used effectively and in agreement with established successful instructional practices (Marzano, 2009). When
integrating technology into daily lessons, technology is just a part of the overall picture, with teacher pedagogy and content equally as important. To piece all three components of an effective technological lesson together, current effective instructional methods need to be updated and aligned with newer digital learning methods.

**Different instructional approaches for technology.**

With the increased presence of technology in today’s schools, new theories of instruction have been created, updating previous theories to today’s digital age. Preceding knowledge regarding how to teach students has to be adapted with new information about how technology can and should be utilized in the classroom. Many teachers currently utilize instructional practices developed for traditional teaching practices while teaching with technology, as they do not have an understanding of newer approaches. Therefore, many teachers are currently attempting to modify their own teaching to teaching with technology, without clear guidelines on how this should be done (Kop & Hill, 2008). Teaching with technology cannot be accomplished effectively by only using instructional practices developed before and without regard to the digital age (Ally, 2008).

Teachers must understand the principles of connectivism in order to effectively update and create lessons that utilize technology, as previous theories do not fully address all aspects of teaching with technology (Bell, 2011). Connectivism does not, however, fully address how teachers should structure lessons and how teachers should interact with students while using technology. While many of the principles of the connectivist tradition still apply, as students are engaged in learning through technology, the elementary classroom is not a true online learning environment. The teacher is also
present and guides students through activities. Therefore, teachers must be cognizant of the emerging digital age theories of teaching such as connectivism, while also being aware of other instructional methods and theories, modifying and adapting their instruction accordingly.

**Merging of technology and pedagogy.**

When integrating technology, teachers should utilize current learning models, in combination with the new methods of connectivism in order to successfully adapt lessons to the current digital age (Ally, 2008). To incorporate technology into the classroom, it should be structured around well-designed activities in order to be effective (Tolentino et al., 2009). Technology must be used as a pedagogical tool, employed in conjunction with active learning and other core principles of effective instructional practices in order to affect and improve learning (Strudler, 2010). By incorporating technology with aspects of well-designed lessons utilizing effective instructional practices, students will be able to benefit from the potential rewards of technology.

Currently, many methods of technology integration are technocentric, concentrating on the technological aspect, without close attention being paid to the content and pedagogy of the lesson. Technocentric teaching with technology focuses too intently on the technology, without regard for how the lesson is being taught. Too frequently, teachers who integrate technology begin planning a lesson with the technology in mind, only later attending to the content. This method of teaching leaves too little emphasis on pedagogy and content. Instead, all elements of an effective lesson with technology (content, technology, and pedagogy) should be in the forefront of a teacher’s mind when constructing a lesson. While attention to how technology should be
utilized in the lesson is vital, ensuring that content and pedagogy also remain a priority when constructing lessons is key to developing effective lessons. Teaching methods need to merge aspects of content, technology, pedagogy, and context to create effective and engaging lessons (Harris, Mishra, & Koehler, 2009). Merging all aspects together will ensure that teachers are not simply using technology haphazardly, but rather as an important element of a well-developed lesson, strong in both its focus on content and also on the use of technology.

In order to modify instruction to teach with technology, teachers must incorporate methods of effective instruction such as constructivism with new pedagogies for learning with technology (Cuthell, 2006). Constructivist approaches have been found to have a better fit with technology use as compared to teacher-centered traditional approaches where the teacher conveys content information to students (He et al., 2012). Successfully integrating technology into the classroom necessitates teachers finding a balance between utilizing technologies as just a tool and radically altering teaching to be solely based on technology. Instead, teachers need to modify their methods of technology integration to include aspects of effective instructional practices, with a focus on the emerging principles of connectivism and digital learning. One way to incorporate technology into the classroom is through teaching 21st century skills. Twenty-first century skills and technology are often taught collectively as they both include similar ideas and pedagogical practices.

21st Century Skills

The sets of skills vital for success in the current and changing workforce are frequently referred to as 21st century skills. Twenty-first century skills are composed of
specific skills essential for success in an increasing number of jobs throughout the world. These skills are problem solving and critical thinking, collaboration and communication, and innovation and creativity (Partnership for 21st Century Skills, 2009). While many of these skills have always been important, they are now even more crucial for students to learn, as the majority of jobs in today’s society requires proficiency in all of these areas. As 21st century skills become prominent in jobs, many secondary schools and even middle schools have attempted to include these skills in their curriculum to ensure students are better prepared. Therefore, in order to be successful in secondary school, students must have knowledge of and practice with 21st century skills in elementary school.

Importance of 21st century skills.

The importance of 21st century skills continues to grow as the world continuously changes. Due to the globalized and networked world of today, jobs are becoming progressively more complex. Menial jobs are being replaced by technology or are sent overseas, and more jobs in the United States require employees to solve intricate problems, necessitating not only content knowledge, but higher-level process skills as well. Many of these jobs often require knowledge of science, math, technology, and engineering (American Management Association, 2010). To be successful in such jobs, students will need to increase their 21st century skills, namely their abilities in problem solving, creativity, critical thinking, collaboration, and also their technological literacy.

Even though demand for a more skilled workforce is growing, the United States is currently producing fewer students with necessary credentials (Nugent, Kunz, Rilett, & Jones, 2010). American students, when compared with students in similar countries
throughout the world, are ranked 22nd in science and 31st in math (Burke & McNeill, 2011). While other nations continue to improve their workforce and become even more competitive in the economy, the students in the United States keep falling more and more behind. Furthermore, lower-wage workers across the globe are vying for jobs that were once exclusively held in the United States. Additionally, leading edge scientific advancements are now being done in many places throughout the world; with the United States no longer the sole place for innovation (Committee on Science, Engineering, and Public Policy, 2007). To ensure that the United States remains competitive with other nations, schools must include opportunities for students to build upon and become proficient in 21st century skills.

Previously, a solid base of reading, writing, and math were crucial for success in society. With a foundation of the “three Rs,” all students were expected to have the capability to achieve in the workforce. This is, however, not the case anymore. Besides the basic foundational skills, many of the new and upcoming jobs require students to have solid math, science, and technology backgrounds. Technology integration can facilitate teaching and learning of all content areas. Through technology, teachers can expand students’ learning in content areas, while also presenting the information in an authentic way. By incorporating technology with core subject areas, students will be more motivated and engaged with the content, facilitating deeper learning of all essential content areas.

Subject areas such as these also require students to possess complex problem solving and critical thinking abilities, creativity, collaboration skills, and technological literacy, the 21st century skills (American Management Association, 2010). Therefore, in
order to be successful in core content areas, students will also need to hone their 21st century skills. Science, math, and technology rely heavily on knowledge and application of 21st century skills. As these subjects become more prevalent in secondary school and middle school, it is vital to begin to prepare students and allow time for student practice in elementary school. By teaching and developing 21st century skills at an early age, students will have more success in middle school and secondary school, when an advanced understanding of skills is crucial for success in a plethora of subjects.

**Necessity of early introduction of 21st century skills.**

In order to ensure that students develop and perfect these skills, 21st century skills must be introduced to students early. In the Massachusetts Common Core Standards, standards that are targeted at preparing students to become productive citizens, elements of 21st century skills, are abundant for elementary students. Beginning in kindergarten, the standards are targeted at improving students’ communication, collaboration, problem solving, and critical thinking and in increasing students’ technological literacy (Massachusetts Department of Elementary & Secondary Education, 2011a). The presence of these standards emphasizes the importance of learning and utilizing 21st century skills at a young age. Standards written for subsequent grades build upon these basic 21st century skills. For students to be successful in their educational careers, they will need to meet these standards in their early elementary years, as these standards are building blocks for the rest of their education.

Learning the importance of 21st century skills and becoming competent at using these skills early on will allow students to succeed in later school endeavors and will also encourage students to pursue diverse types of classes and education. Since jobs are
requiring additional skills besides the traditional writing, reading, and arithmetic, it is crucial to encourage more students to pursue education and careers related to other subjects, such as science, technology, engineering and math (STEM). Becoming successful in utilizing 21st century skills will enable students to succeed in these subjects, thus enticing more students to pursue less traditional paths of schooling. Fostering students’ 21st century skills and technology use in elementary grades will help to ensure that more students opt for Advanced Placement science classes in secondary school and ultimately choose STEM majors when in college (Vaidyanathan, 2012). All the same, regardless of the field students decide to enter, they will, most likely, be required to use 21st century skills on a daily basis, both in school and when they leave school.

**Integration of technology and 21st century skills.**

To fully prepare students for later school, higher education, and the workforce, it is imperative that schools begin to introduce and encourage 21st century skills. Technology can provide an effective way to teach and reinforce 21st century skills. Incorporating technology and 21st century skills while teaching not only provides a time efficient method of integrating both areas, but also provides students with lessons more representative of actual jobs.

There are many different methods of teaching with technology while integrating 21st century skills. Some methods of teaching with technology and 21st century skills build on previous methods of teaching, updating methods to include the use of technology, such as problem-based learning (PBL) and small group work updated to include the use of the interactive whiteboard (IWB). Other methods are new practices, having been solely utilized in conjunction with technology. Some methods utilized
solely with technology are multi-user virtual environments (MUVEs), mixed reality experiences, and Twitter and blogging. While many practices of integrating technology and 21st century skills have been utilized, the effects of utilizing this technology on elementary classrooms are not well documented. Many of the methods have been more frequently adapted to high school and middle school classrooms, with the appropriateness of these methods on the elementary classroom undocumented.

Problem-based learning is one method of teaching, which has been successfully updated in some classrooms to include aspects of technology and teaching 21st century skills. In problem-based learning (PBL), students are given an ill-structured problem. They must hypothesize, collect and analyze evidence, and collaborate with others in order to solve the problem. Through PBL, students incorporate the use of critical thinking, metacognitive self-regulation, and collaboration (Sungur & Tekkaya, 2006). In this method of learning, students investigate authentic problems, facilitating the application of information and skills learned in school to the greater world. Problem-based learning is a pedagogy that can be used in classrooms with and without technology. While traditionally it was utilized without technology, incorporating technology throughout the PBL process can increase the authenticity of the activity, as well as better prepare students to use technology educationally.

Technology can be used in many ways during PBL. Students can utilize different types of technology to generate ideas, collect and analyze evidence, and refine ideas as they continue through the steps towards solving their problem. Technology allows students to be active learners, with the teacher acting as a guide, supporting students through the process. Technology enables all students to participate, allowing students to
succeed who normally might not in a traditional classroom (Swartz, Balkin & Phillips, 2003).

As in many board meetings or other jobs, much problem solving occurs virtually, through technology like e-mail or messaging, all completed without engaging with a person face to face. Furthermore, many middle schools and secondary schools are increasing the amount of virtual learning and educational technology being utilized. Therefore, students should be exposed to the same realities in elementary school to fully prepare for the challenges 21st century jobs and secondary schools offer (Dede, 2007).

Currently, few problem-based learning opportunities make use of technology. Therefore, the real world significance of the problems students are solving is not authentic. This removal from the real world makes transfer to actual situations much more difficult, as the activities students are engaging in are not representative of situations they will actually experience in future jobs or in secondary school (Dede, 2007). As a result, incorporating technologies through PBL has the potential to enhance students’ ability to use technology and learn classroom content, while also preparing students for secondary education, higher education, and the workforce.

Another way to integrate technology in the classroom, a method often utilized in conjunction with PBL, is a multi-user virtual environment (MUVE). A MUVE works similarly to a video game, except the content is based on educational standards (Dede, 2007). Curriculum in a MUVE is learned through both inquiry practices and coverage of state and national content standards (Ketelhut, Nelson, Clarke, & Dede, 2010). The user explores a setting through an avatar and must investigate and solve a problem based upon the specific MUVE (Dede, 2007). MUVEs allow multiple participants represented as
avatars to enter a virtual world, interact with digital artifacts, and communicate with other avatars. Through collaborative learning activities, the student, as an avatar, follows the inquiry process to solve a virtual problem, utilizing e-mail, instant messaging, and blogging to communicate with other students (Warren, Dondlinger, & Barab, 2008). During these activities, students engage in all different aspects of inquiry, such as making observations, examining evidence, planning investigations, and testing hypothesis. Multi-user virtual environments are designed to mimic authentic scientific inquiry, allowing students to utilize technology to truly act as scientists (Ketelhut, Nelson, Clarke, & Dede, 2010).

An example of a MUVE is the River City project, designed for 6th to 9th graders. This MUVE is based on science standards from the National Science Education Standards, technology standards from the National Technology Education Standards, along with content designed to enhance 21st century skills. Students collaborate in teams of three or four participants in an attempt to discover why people are becoming sick (Dede, 2007). Another example of a MUVE is the Anytown MUVE, one of the few simulations designed to focus on students’ writing. In this MUVE, students use collaborative technology tools such as text messaging and e-mailing other students and avatars in order to solve a problem. The MUVE is based upon PBL and integrates problem solving with writing (Warren, Dondlinger, & Barab, 2008). While MUVEs are becoming increasingly popular and allow students to explore content standards in authentic ways, few MUVEs originally were designed and suitable for elementary students. However, with the success of MUVEs at the middle school and secondary level, recently researchers have begun developing MUVEs for the elementary grades,
such as a recent MUVEs based on a virtual farm where students can play the role of a farmer and observe growth online, allowing students to experience essential science experiments that many schools cannot duplicate in real life (Chang et al., 2012).

Another similar way to integrate technology into the classroom is through mixed reality teaching and learning. Mixed reality combines real world components with interactive digital media. An example of a mixed reality classroom is the Situated Multimedia Arts Learning Lab (SMALLab). In this mixed reality classroom, chemistry students explored concepts with “glowballs” and wireless peripherals that allowed students to interact with each other and experience scientific concepts through all of their senses. Students discovered the lesson content through an inquiry approach to learning, in so advancing students’ ability think critically, problem solve and communicate with others. While some uses of technology can be isolating from peers, utilizing mixed reality environments increases interactions with peers, promoting collaboration with other students (Tolentino et al., 2009). Thus far, SMALLabs have been utilized primarily in secondary classrooms, such as in this chemistry classroom. However, many of the advantages to using SMALLabs such as increasing students’ critical thinking, ability to problem solve, and collaboration, are also essential skills for elementary students.

Through the MUVEs, PBL, and mixed reality experiences, students were able to practice and improve upon skills that parallel many of the activities in workplaces (Dede, 2007). Students were able to apply content knowledge to actual situations, thereby learning how to problem solve, collaborate, and think critically. Mixed reality experiences and MUVEs incorporate 21st century skills throughout the process, while also reinforcing content information, thus making both methods of technology integration
potentially very effective. While few of these experiences are currently in place in elementary classrooms, adapting these methods of teaching through technology to the elementary classroom could be an important approach in preparing students for the challenges they will experience in their educational careers.

An additional way to increase students’ proficiency with 21st century skills through the use of technology is to utilize technology such as an interactive whiteboard (IWB) in small group activities. The IWB can be used effectively by students to increase collaboration in a group setting. By using the IWB for small group work, students can more easily share ideas and make decisions collaboratively. As small groups collaborate on the IWB, it becomes a dialogic space where students can make notes, search for more information and come to a consensus together more easily than students working at a single computer (Mercer, Warwick, Kershner, Staarman, 2010). The collaboration space of the IWB allows use of the zone of proximal development, with students and the teacher scaffolding others’ work, so that all students are able to work at a more advanced level than when working independently (Blau, 2011). The teacher can scaffold students’ thinking by providing links on the IWB, along with a sequence of steps to follow. The students also have instant access to material necessary to solve their task. In a study completed in an elementary classroom with one group of students working collaboratively on the IWB and one group of students working collaboratively with pencil and paper, those working with the IWB worked longer on the task together and all group members participated more easily (Mercer et al., 2010).

Along with the IWB, the use of technological tools such as blogs and Twitter can also provide collaboration space for students to increase their skills. Blogs provide an
outlet for students to publish their own work and create conversation with others about their thinking. Through this conversation, students can be pushed past their original thinking, increasing students’ level of critical thinking. Blogs provide a space for teachers, other students, and even parents to communicate with each other about what they are thinking, continuing the conversation. It also encourages collaboration as students work together to create a post for their blog and then improve upon each other’s posts by commenting to each other. Blogs have been shown to increase students’ quality of work in writing, as students work to write for the different audiences they reach on a blog (Frye, Trahen, & Koppenhaver, 2010).

A similar way to increase the quality of students’ writing through the use of technology is by using Twitter. On Twitter, responses can only be a certain length, so students tweeting about activities in their classroom must work to refine their tweets by encapsulating only the key ideas. In an elementary classroom where Twitter was used by the teacher and students to communicate to parents about classroom learning, students wrote for an authentic purpose and a true audience, thus increasing students’ motivation and willingness to write. Students also collaborated with their classmates in order to create group tweets, improving upon collaboration and problem solving skills (Kurtz, 2009).

An effective method of integrating technology into the classroom is by utilizing technology as a tool to incorporate 21st century skills. Twenty-first century skills such as collaboration, problem solving and critical thinking, creativity, and technological literacy are all vital for students to practice, so that they will be well-prepared as they enter society. Problem-based learning, multi-user virtual experiences, mixed reality
experiences, blogs and Twitter are all ways to integrate these skills and technology into the classroom.

While much research has been done on the instructional practices used with technology in middle school and high school classrooms, limited research has been done on technology use in elementary classrooms. While middle school and secondary school students are considered proficient readers and are now reading to learn, elementary students are learning to read and many elementary students are just beginning to become familiar with technology. Some elementary students have not had any prior experience with technology, requiring teachers to provide technological instruction prior to content instruction with technology. While other elementary students may know the basics of operating technology, few have utilized technology for educational purposes before. Elementary students’ lack of proficiency with reading also means that teachers must demonstrate how to use technology, rather than relying on students to follow written instructions, as teachers in middle school and secondary school might. Furthermore, elementary students are beginning their educational careers and are only beginning to learn independence. Elementary students need more frequent guidance and support than older students, as they have not become independent learners (Couse & Chen, 2010). However, technology can help to increase the level of independence and allow students to work at higher levels if students know how to appropriately use the technology (Englert, Manalo, & Zhao, 2004). Further research on more effective ways to integrate technology into the elementary classroom is necessary in order to uncover methods of teaching with technology that will provide similar advantages for elementary students, including better
preparation for secondary school, increased academic achievement, and improved engagement and motivation.

**Literature Review Conclusion**

In order to utilize technology in a way that will affect student learning and increase students’ ability to succeed in society and in later education, researchers must further explore the intersection of technology integration, effective instructional practices, and 21st century skills, rather than focusing on each area as a separate entity. Technology can be an effective tool in the classroom, but, as many researchers have found, the benefits can be limited depending on how technology is used. While technology can be effective in increasing students’ academic achievement, the strategy used with technology is much more vital than the quantity of technology. To use technology in a successful way, teachers must utilize effective instructional practices and must understand the rationale behind online learning theory. Teachers must update their traditional lessons to incorporate technology, keeping in mind the principles of online learning theory in the new digital age. Furthermore, elementary teachers must also integrate technology in a way that will better prepare students for middle school and secondary education. To succeed in their educational careers and in the globalized world, students will need also to become proficient with 21st century skills. There are many methods to incorporate technology with 21st century skills, which serves to increase students’ proficiency in both areas in an authentic way. This study explored how all three areas (technology integration, effective instructional practices, and 21st century skills) can be investigated in conjunction with each other to describe the different ways that teachers utilize technology in elementary classrooms.
Chapter III: Research Design

Research Questions

This research study explored and described the strategies that teachers used for technology integration and incorporation of 21st century skills in an elementary classroom. Many schools are investing in vast amounts of technology, but few teachers are knowledgeable and aware about how to effectively implement the technology in their daily lessons. To address this problem, this study investigated the ways that elementary teachers who currently utilize technology integrated technology and 21st century skills into their daily teaching and described how multiple stakeholders in the district felt about this integration.

The study took place in all three elementary schools in a school district in Central Massachusetts. It examined how teachers and students described their experiences and how they utilized methods of technology integration, how these methods were utilized with different content areas, and in what ways these methods integrated 21st century skills. Through qualitative inquiry, the research questions examined how teachers and students described their experiences with technology integration in elementary classrooms. Through thick descriptions and multiple perspectives, this study described different ways of integrating technology in elementary classrooms.

The first central research question that this study addressed was:

• In what ways do teachers in elementary schools in a school district in Central Massachusetts integrate technology into their daily teaching?

The secondary questions designed to elucidate and clarify the primary question were:
• How do students describe the different methods of technology integration in their classroom?
• How do teachers make sense of different methods of technology integration?
• In what ways do teachers integrate technology during different content areas?
• How did teachers learn to use technology while teaching?
• What types of technology do teachers use in the classroom?

In order to further investigate the methods that teachers utilized to integrate technology into the classroom, the second central research question that this study addressed was:

• In what ways do teachers in elementary schools in a school district in Central Massachusetts address 21st century skills while teaching with technology?

The secondary questions related to the second central research question examined the ways that teachers integrate technology with the differing 21st century skills. The secondary questions were:

• What knowledge do teachers have about 21st century skills and how to plan lessons incorporating these skills?
• How do teachers incorporate technology with creativity and innovation?
• How do teachers incorporate technology with problem solving and critical thinking?
• How do teachers incorporate technology with collaboration and communication?
• *How do teachers incorporate 21st century skills and technology into different content areas?*

In this study, different methods of technology integration as well as the different types of technology used with these methods were examined. Students' and teachers' descriptions, which were captured through interviews and observations, illustrated the various ways that technology can be integrated into the classroom and the relevance and importance of 21st century skills. Through the research questions, descriptions were constructed that delineated potential strategies for integrating technology into an elementary classroom.

**Methodology**

**Approach.**

This study is classified as a qualitative study for a number of reasons. The research questions were designed to describe the process by which elementary teachers integrated technology into their daily teaching and how they addressed 21st century skills through the participants’ perspectives. In qualitative research, the main purpose is to achieve an understanding of the perspectives of the participants (Merriam, 2009). Furthermore, Creswell (2009) and Merriam (2009) identify qualitative inquiry as being an inductive process, with the research shaping the emergence of patterns and themes. Throughout this study, the data were utilized to build concepts, inductively moving towards a more thorough understanding of the different strategies of technology integration. The data gathered through observations and interviews allowed the development of thick descriptions illustrating the methods of technology integration, another key aspect of qualitative inquiry (Creswell, 2009). The thick descriptions were
aimed at developing a complete and holistic account of technology integration in the classroom. Through examining multiple sources of data, such as interviews, observations, and archival documents, and reporting multiple perspectives, the study depicted a comprehensive view of technology integration in the classroom. Developing holistic accounts of the problem of practice is an essential component of qualitative research (Creswell, 2009).

This study utilized a case study research design, a form of qualitative inquiry. A case study was the most appropriate research design because technology integration is an authentic problem that must be understood in the context of the classroom. A case study allowed for close examination of technology integration in elementary classrooms. Examining the context (elementary classrooms) was crucial in fully understanding and investigating the research questions. As in any case study, many different sources of data, such as archival documents, interviews, and observations, were gathered in order to understand the holistic picture of technology integration, enabling the development of thick descriptions of technology integration. Furthermore, the case study is bounded by the school district within a certain period of time. Only information regarding elementary schools in a suburban school district in Central Massachusetts during a one-year time frame, the academic school year 2011-2012, will be utilized.

This study was a descriptive, single-case design. The unit of analysis was the elementary schools in a suburban school district in Central Massachusetts. Within this case, there were subunits of teachers and their classrooms at each elementary school. The unit of analysis (elementary public schools in a school district in Central Massachusetts) was the single case, which allowed for examination and investigation of the research
questions and for development of descriptions of the different ways that teachers integrated technology in elementary classrooms throughout the school district. The study also examined individual teachers utilizing technology in the classroom, in order to provide an in-depth description of teachers’ perceptions on technology integration in their classroom. Additionally, the study investigated the teachers’ classrooms a whole, the second subunit of analysis, in classrooms with already present technology integration to provide additional perspectives to construct a complete picture of technology integration. An embedded, single-case design was most suitable for exploring the research questions, as it allowed for development of a holistic and contextual description of technology integration in elementary schools in a school district utilizing multiple perspectives (Yin, 2009).

Site and participants.

The site of the case study was a school district in Central Massachusetts. The site consisted of all three elementary schools in the district, two kindergarten through second grade schools and one third grade through fourth grade school. In each school, two teachers were selected as a subunit of analysis, for a total of six teachers. The teachers were purposefully selected based on their use of technology integration in the classroom. Purposeful sampling is utilized frequently in qualitative studies to select participants who will provide the most beneficial information to the researcher (Creswell, 2009). Purposeful sampling was essential in this study in order to identify teachers who integrated technology into their classrooms on a daily basis. This sample of teachers provided the most insight into the different strategies that teachers used to integrate
technology into lessons (Merriam, 2009). Participating teachers were then asked to participate in interviews and were observed during lessons utilizing technology.

Throughout the lessons, the teacher’s classroom, the secondary unit of analysis, was also observed. Individual students were not observed, but the class of students as a whole was observed, noticing how entire classrooms of students reacted to the technology lessons in general.

**Data collection.**

Multiple sources of data were used for this study. In case studies, multiple sources of evidence are often utilized, providing the researcher with a more complete and holistic view of the problem of practice. Multiple sources of data create converging lines of inquiry that triangulate and corroborate the data (Yin, 2009). In this study, the TSAT, technology background gained from the Technology Director for the district, interviews with teachers, and observations of teachers and their classrooms were used as data sources. The information from the TSAT was utilized to augment interviews and observations of teachers, offering additional information about the ways in which the teacher utilized technology when teaching. Background information gained from the Technology Director was used to create a holistic picture of technology use in the district, including the technology budget and the quantity of technology available at each school. Interviews of teachers provided information about how teachers described and felt about technology in the classroom. Observations of classrooms provided firsthand knowledge of how technology was utilized and how teachers and students participated.

To collect data, teachers were first provided with copies of the TSAT, so that teachers could self-administer this assessment. The TSAT was utilized since this is the
technology assessment identified by the Massachusetts Department of Education. The TSAT is utilized in many school districts in Massachusetts to address professional development needs and is also utilized by the state to gather and report technological competencies. Additionally, the TSAT was used as it directly aligns with Massachusetts Technology Standards (Massachusetts Department of Elementary & Secondary Education, 2010a).

Next, and also throughout the research study, information regarding background information on technology use in the district was collected. This information was collected from the Technology Director utilizing the following questions as a guide:

- **What is the total district budget for technology? How much of the budget is allocated to each elementary school?**
- **What kinds of technology are available in the elementary schools? What quantity of each kind of technology is available? How is the technology spread across the three elementary schools?**
- **What training has been provided to staff regarding technology? What training is planned for staff in the future? Does training for staff relate to use of technology or integration of technology in curriculum?**
- **What positions related to technology are present in the district? What are the specific job descriptions of these positions?**

After this phase, teachers participated in interviews. The interviews were open-ended and were structured as “guided conservations” in order to glean the most information from teachers. The interviews with teachers were in-depth interviews where teachers were asked to explain lessons and their opinions on technology integration in the
classroom. The interviews were fluid and were adapted according to the teacher and the teacher’s responses (Yin, 2009).

Along with interviews, observations of teachers were utilized as data sources throughout the study. The researcher was the sole observer and observed lessons that incorporated technology in order to supplement information gathered through interviews. Teachers were observed during the day, teaching lessons in all main academic content areas, such as language arts, math, social studies, and science. During observations, specific aspects of the lesson were attended to by utilizing an observational protocol to gain information helpful for comparisons with interviews. Both the interviews and the observations investigated the following questions:

- *How was technology utilized in lessons?*
- *What kinds of technology were used?*
- *How were lessons utilizing technology structured?*
- *What were the strengths of the lessons integrating technology?*
- *What were the weaknesses of the lessons integrating technology?*
- *Was technology utilized differently depending on the content areas?*
- *Was there a focus on 21st century skills in lessons integrating technology?*
- *On which (if any) of 21st century skills was the lesson focused?*
- *What role(s) did teachers and students play in lessons utilizing technology?*
- *How did students respond to technology integration in the classroom?*
- *How did the teacher learn to utilize technology?*
- *What more would the teacher like to learn about technology?*
- *How would students like technology to be incorporated into the classroom?*
Data analysis.

Through interviews, observations, and documents, a large amount of information was gathered. Therefore, it was necessary to analyze and code the data in concrete ways in order to investigate the research questions. Case studies tell a story that is grounded in data. In order to develop this story, a carefully guided analytical strategy was followed (Yin, 2009). This strategy consisted of two main phases of data analysis.

Phase 1. Following the first round of data collection, information from the TSAT was analyzed. In order to analyze data from the TSAT, descriptive statistics were used to compare and contrast the different ways that teachers integrated technology into the classroom. Information from the “Teaching and Learning with Technology” subsection of the TSAT was analyzed to develop and supplement descriptions of how teachers utilized technology in their classrooms. This subsection of the TSAT was analyzed to examine the similarities and differences between how the participants made use of technology in the classroom.

Technology background information gathered from the Technology Director was then analyzed to provide a holistic view of the technology available in the three elementary schools, along with information regarding the technology budget.

Phase 2. Following the first phase of data analysis, the second phase of analysis commenced, which involved analyzing interviews and observations of teachers and their classrooms.

In order to analyze interviews and observations, initial codes were formed through open coding after reading through observational notes and transcriptions of interviews. To develop codes and thoroughly analyze the data, the data were coded for three distinct
purposes. First, the data were read and coded for a descriptive purpose utilizing open coding. The purpose of the first round of coding was to develop a larger picture of the case and begin to develop interesting and potentially relevant categories (Merriam, 2009). Through attending to the research questions, the data were coded for a descriptive purpose to unveil the overall and holistic “story” being told (Ellinger, Watkins, & Marsick, 2005).

In the next phase of coding, observational notes and interview transcripts were read and coded for an analytic purpose, utilizing axial coding to group open codes together in order to create categories of groups of open codes (Merriam, 2009). This phase focused on looking more closely at the details of the data in order to answer how and why different events occurred. This phase of coding pursued the underlying rationale for the descriptive events that were read and coded for in the first phase (Ellinger, Watkins, & Marsick, 2005).

Finally, the data were coded for a third purpose; an interpretive purpose. The intention of this phase of selective coding was to integrate all pieces of data together, utilizing all pieces of data, while also attending to the theoretical frameworks of the study. While the three phases built upon each other, each phase did not occur in complete isolation and phases had some overlap. Overall, though, each phase progressed to the next in order to establish a holistic view of the problem (Ellinger, Watkins, & Marsick, 2005).

Patterns of coding were then established, by first coding within each subunit and then across the different subunits. Throughout the data analysis process, measures were taken to establish reliability. First, reflective memoing was utilized in order to capture
thoughts and reflections throughout the process. In the reflective memos, emerging themes were reflected upon (Maxwell, 2005). Peer review was also utilized where emerging themes and interpretations were discussed with colleagues to obtain additional perspectives (Merriam, 2009).

**Validity & Credibility**

In a qualitative study, trustworthiness refers to the researcher ensuring that the findings of the research are worth noting. Lincoln & Guba (1985) described multiple ways that researchers can establish trustworthiness and ensure credibility. To ensure the credibility and trustworthiness of this study, certain protocols and steps were followed to control for bias. By clarifying a researcher’s biases and developing deep, thick descriptions throughout the study, others can determine the degree of transferability to their own setting (Merriam, 2009). A diverse group of participants was purposefully selected. Data collected were triangulated, both through multiple data sources and multiple participants, to substantiate findings. Alternative explanations and data not supporting the findings were also investigated. Member checks with participants were conducted to check the accuracy of findings and peer debriefing was utilized.

To deal with researcher bias, the researcher clarified her biases so that those reading the study would be able to see the vantage point of the research study and assess the degree of transferability (Creswell, 2009; Merriam, 2009). Through her background as a first grade teacher interested in technology, the researcher had biases about the importance of technology in the classroom. The researcher believes that technology should be a vital component of daily lessons in order to prepare students for the realities of today’s society. Furthermore, the researcher believes that technology must be fully
integrated into the core content of the lesson, providing students, and not just teachers, with opportunities to make use of the technology. The researcher also believes that 21st century skills should be integrated into the classroom in a daily basis. She believes that 21st century skills can be effectively incorporated with technology, making lessons more authentic and representative of society. Explaining and clarifying the researcher’s biases will allow the reader to understand how these biases might impact the research study (Maxwell, 2005). Other procedures to guard against biases were also taken.

Multiple teacher participants were purposefully selected from each elementary school in a school district in Central Massachusetts to have a more representative sample of all elementary schools in this town. By utilizing participants from each school, differences between schools could be accounted for, such as students’ ages and the school culture.

Additionally, data sources were triangulated. By utilizing multiple data sources, such as results from a technology assessment, documents, observations, and interviews, the evidence could be examined to see whether the different sources corroborated each other, resulting in more credible findings (Creswell, 2009). Data were also triangulated with different participants, through interviews with multiple teachers (Maxwell, 2005; Merriam, 2009). The observations occurred at multiple times to ensure that a complete picture of the classroom was being perceived and all details were accurately portrayed (Creswell, 2009; Maxwell, 2005).

While collecting data, alternative explanations of the research were investigated (Merriam, 2009). Data that did not support emerging theories were searched for to guarantee that the researcher was not simply looking for certain types of data based on
her biases (Maxwell, 2005). Diverging perspectives and evidence were presented so that the reader could understand all aspects of technology integration (Creswell, 2009).

Others resources were also utilized to ensure the accuracy of the data. Member checking was employed to ensure that the participants felt the findings are accurate and representative of each classroom. With colleagues who were not participants, peer debriefing was utilized to review and question the accuracy of the findings (Creswell, 2009; Lincoln & Guba, 1985). Furthermore, the data were written up with thick, rich descriptions to give the reader a holistic picture of what is occurring in the elementary classrooms, allowing the reader to envision a clear and realistic picture of technology in elementary classrooms and better enabling the reader to assess the degree of transferability (Creswell, 2009; Maxwell, 2005).

An audit trail was created throughout the research study. The audit trail will enable independent researchers to follow the path of the researcher, demonstrating how all data were collected and analyzed. All steps were described in detail utilizing a research journal to ensure others would be able to authenticate findings (Lincoln & Guba, 1985).

**Protection of Human Subjects**

This study provided teachers and students with as much ethical protection as possible. While the research did not present any apparent risks to participants, measures were taken in order to provide teachers and students with complete anonymity and accurate representation (Creswell, 2009). Teachers and their classrooms participating in the research were observed in their natural setting with no interventions occurring that could limit achievement in the classroom, therefore minimizing the risk of harm to
participants. In order to protect participants’ confidentiality and anticipate the potential of harmful information about teachers’ teaching methods or students’ learning, all measures were taken to protect participants’ anonymity.

Participation in the proposed study was voluntary. Teachers were notified about the goals and intentions of the study. Participants were aware, from the beginning, of the details for participation and were required to provide written consent.

To protect anonymity, teachers were given pseudonyms. Furthermore, to ensure that participants were portrayed accurately, teachers were debriefed about the findings. Member checking was utilized, so participants could verify the accuracy of all data and findings (Creswell, 2009). To protect teachers from being unfairly evaluated through this research, an agreement was obtained with the principal and the teachers’ union to ensure findings were not used, in any way, as part of an evaluation on teachers.

The researcher’s position as a colleague and teacher in the school system could have potentially influenced teacher participants. Teachers and fellow colleagues might have also felt pressured to participate due to their relationship with the researcher. Therefore, in the written consent form, all participants were informed that participation was completely voluntary and did not impact the researcher’s judgment or opinions.

While there were slight, potential risks for participation in this study, the potential benefits of participation were even greater. Through this study, different ways to integrate technology were highlighted, thus providing teachers already interested in technology with more resources and information about how to successfully integrate technology into the classroom. For students, information about how to integrate
technology will help to improve teachers’ use of technology in the classroom, thus potentially increasing their engagement, behavior, and academic achievement.
Chapter IV: Research Findings

The purpose of this study was to investigate and describe the ways that elementary teachers in a school district in Central Massachusetts utilize technology and 21st century skills in their daily teaching. This chapter summarizes the themes that emerged from the findings from interviews, multiple observations, and technology self-assessments from six elementary teacher participants. The participants were composed of five elementary teachers and their classrooms, ranging from first grade to fourth grade and one first grade reading specialist. Additionally, document data gathered from the chief technology officer for the town was analyzed to supplement information gleaned from teacher participants and their classrooms.

The first central research question investigated the ways that teachers in elementary schools integrated technology into their daily teaching. To explore this question, secondary questions examined how students described the different methods of technology integration, how teachers made sense of different methods of technology integration, the ways that teachers integrated technology during different content areas, how teachers learned to use technology, and the different types of technology that teachers used in the classroom. To further understand technology integration in elementary schools, the second central research question investigated how teachers addressed 21st century skills during lessons with technology. To investigate how teachers incorporated 21st century skills, secondary research questions examined the knowledge that teachers have about 21st century skills and how to address these skills, how teachers integrated creativity and innovation, problem solving and critical thinking, and
communication and collaboration with technology, along with how teachers incorporated 21\textsuperscript{st} century skills into different content areas.

To investigate these research questions, a round of initial interviews with each participant and a self-administered technology self-assessment (TSAT) was given. Next, each teacher was observed conducting multiple lessons utilizing technology. Information garnered from interviews, observations, the technology self-assessment, and the technology background information was then analyzed and coded. Through examination of the codes, themes between the teacher participants emerged, forming a deeper understanding of technology integration in elementary classrooms.

\textbf{Study Context}

The context of the classrooms must be examined and utilized in order to interpret and fully understand the findings. In all five elementary classrooms, the set-ups of each classroom were comparable. The rooms were similar in size and had most of the same types of technology. The interactive whiteboard (IWB) was placed at the front of the room, with a rug for students to sit on in front of the IWB, and the desks were arranged in groups around the rug. Teachers positioned the rug and the groups of desks so that students were able to see the IWB from both places. The computers (between four-six) were arranged around the perimeter of the classroom. The digital document camera was positioned, in all classrooms, right by the computer connected to the IWB, so that the camera could project onto the IWB. Student desks were situated in groups, and teachers frequently utilized the group set-up to facilitate collaboration and communication during lessons. In the reading specialist’s classroom, the room was much smaller since the teacher works with small groups and not a whole classroom. The three computers were
placed on the edge of the room to minimize distraction. The room had a u-shaped reading table, so students could work together and the teacher could interact with all students simultaneously.

Through analysis and coding of interviews, observations, teachers’ TSAT, background information from the technology director, and the context of the classroom, three themes emerged which characterized and described teachers’ use of technology in the classroom and incorporation of 21st century skills. The themes that emerged were the benefits of technology, the various uses of technology, and the incorporation of 21st century skills.

**Benefits of Technology**

The first theme that emerged was that the teachers in this study believed that technology offered many benefits to teachers and students alike. The teachers in this study reported various benefits of technology, including increased student and teacher motivation and engagement, increased relevance to students’ lives, greater ease and accessibility during teaching, and improved instruction.

**Increased student and teacher motivation and engagement.**

**Increased student motivation.** All six teacher participants felt that technology increased student motivation and engagement in the classroom. Student engagement was defined as students exhibiting behaviors critical for learning, displaying social behaviors that influence learning, and not partaking in activities that detract from learning (Finn & Pannozzo, 2004). Student motivation was characterized by students’ beliefs in their ability to complete schoolwork, along with their desire to complete schoolwork (Ryan, 2000). During interviews, teacher participants spoke about the increase of student
motivation when technology was utilized. One teacher participant stated, “I find my level of technology has always been that the kids love it so much. It’s so motivating, and I just feel that they’re excited to learn when they’re using it.” Another teacher participant agreed, “I enjoy it because the kids are so motivated by it. If they’re happy, I’m happy.”

The teacher participants believed that utilizing technology was a way to increase the engagement of students. All teacher participants stated in interviews that they felt students were more actively engaged when they were teaching using technology and were more apt to participate. One teacher participant asserted, “Well, I feel like these kids now like if you’re not using it, they get, like they don’t pay attention. It’s just a different way to approach it, so they’re engaged.” A different teacher participant remarked, “I find that it definitely holds their attention more than I do.”

Another teacher participant reflected, “They really, they love to use the SMART Board. Computers is the first thing they choose if they get their turn to choose first for Daily Five.” A different teacher participant also revealed that the majority of students was excited and engaged to utilize the computers. The teacher participant stated, “And so 95% of the time I want to say that they’re excited. They’re engaged. They’re eager and they’re having a good time [about using the Lexia reading program].” From the interviews with teachers, teachers consistently expressed their belief that students reacted positively to technology during daily lessons and lessons with technology tended to increase students’ engagement more than a lesson without technology.

Some teachers in this study also believed that students’ increased engagement and motivation caused students to be more focused on classroom content, therefore resulting in students learning more information. One teacher asserted, “But I mean, they get more
engaged, so being more engaged, they get more out of it. I mean essentially that’s teaching and learning, I guess.” Another teacher also felt that students love of technology and increase in motivation through technology resulted in students’ increase in achievement in the classroom. The teacher participant believed that utilizing technology as a motivating factor increased students’ work ethic and achievement. The teacher articulated, “I’ll put their papers up under the document camera and like put stars over everything that they did really well. And the quality of the work that they’re turning in the morning has like totally improved.”

Students also expressed their perceptions of the benefits of technology use in the classroom. Multiple students in various classrooms articulated that they preferred using technology because they believed it helped them to learn.

In one observation of a classroom during a math intervention time, a student working on math facts on “FastMath,” relayed his belief of the benefits of technology by stating, “I didn’t do very good, but now I do very good [at math].” In a different classroom observation, a student remarked, “I love Lexia because it helps me with my writing.” The students believe that utilizing technology helps them acquire content information.

The data demonstrated that students appeared to be motivated and engaged by technology, although student motivation and engagement were also dependent on student participation in the lesson on technology and the type of technology utilized.

_Differential motivation based on type of technology._ In one teacher lesson on math, students worked individually or in pairs to review math concepts utilizing technology. Five students worked on computers, playing FastMath, a game designed to
allow students to practice math facts. Four other students worked on iPads, two students on each iPad. All four students working on the iPads remarked that they enjoyed working on the iPads more than either working on the computers playing FastMath or playing math games not using technology. One of the four students also commented about liking iPads the best, but liked math games without technology better than using the computers. The students had preferences for what type of technology they utilized.

The preferences and differential motivation with different types of technology influenced the degree of engagement of students. With the students on the computers, two out of the five students asked to come off the computer before the end of the lesson. After about 15-20 minutes on the computer, both students raised their hands and asked the teacher to switch to a different activity. However, all students on the iPads remained engaged in their activity on the iPad throughout the entire lesson, with no students asking to switch to a different activity or even asking to leave the room for other reasons (such as going to the bathroom or getting a drink). Students’ engagement during this time was dependent on the type of technology.

Another observation in a different classroom in the computer lab also during a math intervention revealed similar feelings from students. In this lesson, students first completed a spelling test on SpellingCity and then moved onto math games on the computer (either EveryDay math or SplishSplash math). When asked about their feelings and perceptions of technology, different students stated various perceptions about the types of technology. For the spelling test on the computer, one student relayed that he liked taking spelling tests on paper, rather than by using technology because of the difficulty of technology, and typing in particular. He stated:
I like writing it on paper because it’s hard to find the keys. When you write on paper, you know how to make the letters, but when you get older you know the keys.

The other students in the classroom were split about their perceptions regarding utilizing the computer lab during math intervention time. Two-thirds of the students (eight out of twelve) were engaged in the math games their teacher had advised students to use. These students stated they enjoyed the math games because they thought the games were funny. The entertainment for students came from graphics when students got things correct on the math game. The other four students asserted that they enjoyed playing on the computer, but did not like the games they had to play. These four students had to be redirected multiple times to play the appropriate game. The students instead played other games on the Internet they found more exciting or other types of software on the computer they had learned previously that they preferred to play. These students were engaged in technology when they were able to play a game of their choice, but were then distracted and unfocused when redirected to the appropriate game for the day.

In multiple lesson observations, students became extremely excited when certain types of technology were used in the classroom, namely iPads, games on the SMART Board or MimioBoard, and videos played utilizing a projector connected to the SMART Board or MimioBoard. During an observation with the teacher utilizing the Weekly Reader website to show students the interactive weekly reader available online, multiple students began shouting, “Wow!” as a video came on that demonstrated the different changes a tree goes through in fast motion. In another lesson observation, a student
screamed, “I love this game!” as the teacher turned on a review game where a hidden
word was behind a curtain, leaving students to figure out what the mystery word was.

However, when other types of technology were used and the graphics were not as
exciting or the technology did not require as much interaction, students did not react in
the same way. In the same lesson on the Weekly Reader website where students
expressed their enthusiasm towards watching the videos, multiple students were
distracted and had to be redirected throughout the course of the lesson. These students
were not engaged during the parts of the weekly reader that contained only text and
pictures and didn’t have videos. When students were expected to follow along with the
pictures and the information presented on the SMART Board, the teacher had to redirect
students multiple times to stay focused and stop fooling around.

_Differential motivation based on student participation._ Along with the
differential motivation and excitement students expressed to the specific type of
technology used, students’ excitement and engagement varied depending on the level of
participation of students. In lesson observations where students were not active
participants, either participating frequently with technology or engaged through other
instructional methods, such as collaborating with a partner or working on an individual
task, students did not appear to be as focused on the lesson.

In a lesson observation during math, students had limited participation in a game
projected on the MimioBoard. Students were split into separate groups, but, for each
question, only one student from the group was called upon to answer the question.
Therefore, for each question, one student was actively participating, while twenty-three
other students were waiting for the next question. During this lesson, students sitting on the rug watching began to chat and started losing focus on the game.

However, in a similar lesson utilizing a game on a teacher participant’s SMART Board, students remained more engaged and motivated. During this lesson observation, students were once again split into groups and were working with their group to solve Jeopardy questions based on a review of weather. During this game, students had to collaborate with their group before answering a question. Since four to five players on each group had to interact to solve the problem together, all players were engaged when it was their group’s turn. This increased the amount of participation each student had because they were answering one out of every four questions (since there were four teams). Even though student participation was not increased with the actual technology, their participation was increased through another method, group collaboration. The students in this classroom were more engaged and engrossed in the game.

In a different classroom observation, students were in the computer lab utilizing the Lexia reading program. Each student had his/her own computer, thereby increasing the amount of participation with technology. During the 30-minute time in the computer lab, nine out of the ten students were engaged and focused on the technology throughout the entire lesson. Students were actively participating with their own technology the entire time. The degree of participation (either participation through technology or participation with other methods) influenced the reaction of the students.

*Increased teacher motivation.* Two teacher participants also stated in interviews that they utilized technology because it also increased their own motivation and held their own attention. Teacher participants enjoyed teaching with technology and felt that it
made lessons more exciting and interesting to teach. One teacher relayed that technology was a way to keep lessons appealing and different. The other teacher commented, “I don’t know how to teach without it [technology] anymore.” While the other teacher participants did not explicitly state that they utilized technology to increase their own motivation and interest, during interviews and observations, all six teacher participants showed a love for technology. Teacher participants spoke about technology excitedly, stating things such as their love for the digital document camera and how they could not live without it anymore. When talking about new types of technology possible for their classroom or new types of technology recently acquired, such as iPads and the Smart Table, teachers in this study became very eager and interested about the possibilities.

Through interviews and observations, teachers in this study expressed their belief that technology motivated both students and teachers in school and also increased student engagement. Teachers in this study believed that utilizing technology provided many benefits to students, including making students and teachers more interested in learning.

**Increased relevance to students’ lives.**

Teacher participants, along with believing that students reacted to technology in an excited and positive way, also felt that technology increased a lesson’s relevance to students’ lives. Teacher participants asserted that students felt the need for technology in school because it was a part of their daily lives. One teacher reflected, “I don’t think that my kids think it’s anything special right now because I think it’s so [ingrained] in their lives.” Teacher participants felt students were so used to technology in every other aspect of their lives, it was necessary to incorporate it into their life in school. A teacher
participant stressed, “You need, you kind of have to integrate it at this point because…
these kids could probably use more technology than I.”

Additionally, two teacher participants believed that since technology was an
integral part of daily lessons, students became used to it in the classroom. One
participant relayed, “At first they’re very excited, particularly with the SMART Board,
having it in the classroom. Now it’s just part of being in the classroom, I think. They’re
used to using technology.” However, the other four teachers still believed it was
something special and different for students. Even though students use technology
frequently, these teachers believed that students were still excited to learn while using
technology. One teacher participant stated, “So it’s still special enough that they want to
be able to do it. And I think that they know like compared to like an alternative of what
they would be doing… they’re more interested when technology is used as opposed to
when it’s not.” During a lesson observation, a student using the Lexia reading program
also remarked that he enjoyed reading on the Lexia program better than reading a
traditional book with the teacher. Some teacher participants felt that students got used to
the technology and didn’t find it as exciting when used frequently, while other teachers
still believed that students were excited and interested to use technology and it more
closely reflected students’ lives.

**Ease and accessibility of technology.**

Another benefit of technology that teacher participants reported was greater ease
and accessibility to resources while teaching.

**Increased resources.** Through lesson observations, the data showed that teachers
used technology to access more resources for students than in lessons without
technology. In a social studies lesson utilizing the “Weekly Reader” magazine, a student had a question about the difference in size of the moon and the earth. The teacher was able to not only find out exactly how much larger the Earth was than the moon, but the teacher was able to find a pictorial representation within seconds to show the student. Technology allowed the teacher to answer a student’s question quickly, find a resource, and move on. Another teacher participant added, “I think it provides more resources for a teacher in the classroom that he or she may not have.”

**Ease of finding appropriate resources.** In addition to having access to more resources, teacher participants also reported that technology facilitated teaching, making it easier for teachers to find appropriate resources and to demonstrate different concepts to students. One teacher participant reported, “One of the advantages is it’s really quick moving, so instead of spending a lot of transition time or getting materials ready or having to find things, there’s a lot of really great resources on the Internet.” A different teacher participant added about the ease of technology, “It’s because it’s at your fingertips, you can just get onto United Streaming and you search for what you need and put it into a notebook. It’s ready as opposed to, you know, checking out videos. I mean it sounds kind of lazy, but it’s not. It’s just, we don’t really have a lot of time.”

Furthermore, teacher participants reported that technology allowed them to demonstrate directions to students very quickly, causing students to better understand their expectations and also increasing students’ time on learning. One teacher participant commented, “When I want to do a paper or go over directions, it’s pretty easy to just pull that out and show it up on the SMART Board.” In a lesson observation, a teacher participant utilized the digital document camera to show directions for an intricate math
page. The math page had many different parts, making it hard to explain or recreate on the whiteboard, so the teacher placed the math book under the digital document camera and was able to go through each section of the page step by step, pointing to each section exactly as it appeared in the students’ math books. The technology allowed students to follow along and to complete their work with greater success. The teacher participant stated, “So they’re able to see it there and kind of like, you know, get the directions from me close up, like they were sitting right around me but they’re not.”

**Ability to archive resources.** Finally, technology facilitated storing of lessons and units for teachers. Teacher participants remarked that while it was time consuming to create lessons utilizing technology, they were able to reuse the same lessons from year to year and save the lessons on the technology, using literally no space. One teacher participant stated, “I have a lot of lessons that I’ve developed and saved on there, so it’s pretty easy.” Teacher participants believed that technology made it easier to store and keep lessons they created for the classroom. Another teacher further commented on the ease of creating lessons with technology, “But I, I find that it makes my life easier. That it, and I am, I’m more motivated to create things that I can use with them than I was. Than I am writing everything out, creating charts.” Another teacher participant explained:

But on the computer, I’m much faster at doing that, so it’s just easier for me to do it that way than to get my big chart paper out and plus, I like to. The ease of storing it all in your files by unit, by theme, by subject is so much easier to just keep it all organized and at your fingertips whenever you need it.
Teachers believe that technology made their lives easier and facilitated their teaching by allowing them to reuse resources from year to year, updating and adding to lessons as necessary.

**Improved instruction.**

Through teacher interviews and lesson observations, the data also showed that teachers in this study believe that technology improved their instruction by allowing them to more easily differentiate instruction, reach more types of learners, and allow greater access to the curriculum.

**Enhanced differentiation of instruction.** Four of the six teacher participants felt that teaching with technology facilitated their differentiation of instruction. Certain types of technology (in particular certain software programs and websites) had options for teachers to control the levels at which students were working, which, teachers felt, allowed students to work at their own level in the classroom. Some software programs like FastMath and Lexia enabled students to complete games at their own pace and their own level, moving up as students’ skills allowed. One teacher participant remarked, “it [Lexia] differentiates and changes for the child depending on the child’s individual needs constantly.”

The data showed that teacher participants utilized technology to facilitate differentiation in lessons. In one lesson, three different students took three different spelling tests. In a traditional classroom, this might have been difficult for the teacher to accomplish simultaneously. However, all three students were able to take the spelling test with three different sets of words, utilizing SpellingCity’s website. The website allowed the students to take the spelling test and also allowed the teacher to see the
results of the students’ tests when time allowed. In a different classroom, five different students were reading on a website at the same time at different levels. Students were reading on the Raz Kids website, a website where teachers can control the level of the books students are reading. Students were reading a wide range of books, from a level “A” to a level “K”. The website allowed the teacher the control to ensure that all students were reading appropriately leveled books.

Along with utilizing software to differentiate instruction, teachers in this study believed they were able to differentiate and target instruction with students because of the flexibility technology afforded teachers. Teacher participants spoke about having more time to work on specific skills with groups of students or with individual students because students were engaged in an appropriate activity utilizing technology. During a lesson observation, a teacher participant was able to work with two students at a time while the other students were engaged in the Lexia program. The students on the Lexia program were working on related work, but the technology allowed the teacher to target the individual skills that the two students needed. The teacher stressed, “This actually frees me to do the work with the students that I know needs to be done in the amount of time that I have the students in front of me.”

During another lesson observation, a parent volunteer accompanied a group of students to the computer lab to work on assorted math activities on the computer, while the teacher worked with a small group of struggling math students in the classroom. The technology in the computer lab enabled the teacher to send students with a parent to work on math games the teacher deemed beneficial without needing a parent or teacher with
relevant content knowledge. The teacher was then freed up to work with a small group of students and was able to target instruction based on students’ needs.

*Ability to monitor student progress.* Certain types of technology also allowed the teacher to monitor students’ progress through progress monitoring tools inherent in the software. Four of the six teacher participants spoke about the benefits of using the progress monitoring tools on the computer software programs to track students’ progress and determine where they needed additional instruction. Teacher participants believed that the assessment features on the software programs, namely the Lexia reading program, FastMath, and the Raz Kids and SpellingCity websites, decreased the need for teachers to assess students’ progress in the classroom and instead focus on student instruction. Teachers in this study felt that using the information from the software programs and the websites allowed them to gain important information about their students that they could use to plan additional instruction.

In regards to the Lexia program, one teacher participant commented, “Lexia does an amazing job of validating the in class assessments and observations and actually cuts down on my need to assess, assess, assess. Lexia is constantly evaluating for me.” Another teacher spoke about the SpellingCity website and stated, “It grades it and keeps track of everything for me.” Teachers in this study felt that certain software programs and websites helped assess students and track students’ progress in the classroom. The use of technology for progress monitoring helped teachers to cut down on assessment time in the classroom and better focus instruction based on results of progress monitoring through technology.
**Reaching more students.** A benefit of technology that all teacher participants spoke to at great length was the belief that technology afforded teachers with the opportunity to reach more students, including visual learners, through better presentation of content material, including larger representations, more interesting and realistic pictures, and enhancement of lessons. Furthermore, teachers in this study believed that technology allowed greater access to curriculum for all students.

**Targeted visual learners.** Teachers in this study believed that technology enabled visual learners to thrive in the classroom. One teacher stated:

I think with 24 different students in here, you have to have different approaches. There are still some kids who would prefer to sit at their desk and do a paper. There are some kids who would prefer to sit with their friends and play a math game. There are some kids who learn better when they’re using the technology. I find for the visual learners, it really helps a lot.

Teachers believed that improved graphics and better presentation of information enhanced lessons for visual learners. One teacher spoke about the difference of the visual aspect of teaching with technology versus teaching without technology by stating:

Usually you’re holding up the letters in front of 20 kids, and I thought to myself, wow, why don’t I just put it up on the document reader, you know. So you put it on the document reader and then the kids see it really big and then you’re like, wow, and it becomes a totally different type of activity than just reading aloud to them, you know.

**Enhanced content presentation.** With the use of the SMART Board, MimioBoard and/or digital document camera, teachers were able to demonstrate content material with
larger representations. These types of technologies allowed all students in the classroom to view the same material simultaneously. During a lesson observation on a collaborative jeopardy game on weather, the questions were written on the SMART Board and accompanying pictures were shown. As each question was chosen, all students read the question together, allowing all members in a group to see each associated picture and understand each question.

Additionally, the teachers in the study felt that the technology allowed students to see more accurate and realistic pictures and graphics. One teacher participant referenced the need to illustrate vocabulary accurately as a result of teaching in a sheltered English immersion classroom. The teacher felt it was essential for English Language Learners to see accurate pictures, so these students would be able to understand concepts and stories when they may not have experienced the vocabulary before in real life. The teacher stated:

And you know with the ELL population, having to use as much visual, as many visual cues to supplement what you’re talking about. It’s harder to gather realia [real objects] for them, for their vocabulary that you’re trying to develop without searching. You know, it’s just easier to go to the computer and pull up pictures of farm animals and a barn and… than it is to gather all that material.

One teacher participant remarked about the Lexia program, “I’m noticing like, especially with the ELLs because for our English Language Learners it provides vocabulary for them. You know, the graphics are amazing, and it’s actually teaching them, you know, exactly what they need.”
Five out of the six teacher participants also spoke about utilizing videos to portray accurate graphics and events to students. Teacher participants stressed incorporating videos to increase students’ understanding about a content area through precise and exact videos portraying true events. Teacher participants also stressed utilizing realistic or true videos to demonstrate concepts or places that students might never have the opportunity to experience in real life. Teacher participants felt that videos could transport students to places they might never be able to go. One teacher participant stated:

There are little videos that go with it. So the kids… it really makes those things come alive for the kids. And instead of just doing like a one day thing on a weekly reader, it starts to open their world to what else is out there that they could find.

Another teacher participant agreed, “A lot of these kids are not going to be able to travel to all 50 states. So they’re more apt to learn more about them when you present it in a different way [through technology].”

*Increased access to curriculum.* Teacher participants also felt that technology provided a greater range of students with access to the curriculum. Teacher participants believed that technology provided different avenues for students of various ability levels to participate, thereby facilitating access to the curriculum for students. In particular, one teacher spoke at great length about incorporating technology during social studies in order to allow students of vastly different ability levels the capacity to participate together. One teacher participant declared, “We use the technology for social studies because I have kids that can’t access the curriculum, but with the technology they can.” The teacher further explained:
I have access to the book online, so it reads it to them because the kids can’t read it, so it reads it to them. So that’s really helpful because even, you know, and then we can talk about it. So they’re able to join in discussion after the kids read. So if they’re reading partners or if they’re reading individually, they can read it, so they’re able to join in the discussion. So we use a lot of that technology for like the kids to access the curriculum.

**Various Uses of Technology**

The second theme that emerged from the data was that technology was used for various purposes throughout all participants’ classrooms. Different types of technology were present in all classrooms, and teachers in this study used the various types of technology in a number of ways, depending on the type of technology, the grouping of students, the purpose of the lesson, and the content area.

**Types of technology.**

*Technology.* The most common type of technology, utilized by all six teacher participants, was computers. Through observations, data showed that all teachers had at least three computers in their classrooms, one designated for teacher use and the rest of the computers utilized for students. Teacher participants had between three – six computers in their classroom, with the majority of teachers having three to four computers. Students utilized the designated student computers on a rotating basis in most classrooms since the numbers of computers was much smaller than the number of students. Teachers in this study utilized the computers during centers, independent work time, math intervention, and, for the reading teacher participant, during daily lessons. One teacher stated:
I also am lucky enough to have 5 computers, regular PCs, that the students can use, so we’ll use those. I use those in the morning we do fast math for our facts, our math facts, and I have Raz Kids set up for them so we can use it for that.

Another type of technology utilized frequently and in five out of the six teacher classrooms was the interactive whiteboard. Three classrooms had a mounted SMART Board, while the other two classrooms had a MimioBoard. Both interactive whiteboards work in the similar ways; however, a MimioBoard is mounted onto an existing whiteboard, while a SMART Board utilizes its own screen, which is mounted over a whiteboard. The interactive capabilities of the whiteboards are the same, both connected to a projector and computer, although the MimioBoard can be transported to a new classroom with greater ease. Additionally, a teacher participant reported, “You can use the MimioBoard for anything. And you can, I like it better [than the SMART Board] because you can write over [it].” Since the MimioBoard utilizes the whiteboard and not a separate screen, teacher participants wrote with whiteboard markers on the screen, in addition to using the interactive pens. In classrooms with a SMART Board, only interactive pens were used, since the SMART Board utilizes its own screen, which is not compatible with whiteboard markers.

Five out of the six classroom teachers also had a digital document camera. The digital document camera was utilized frequently by most of the teachers, with the teachers employing this type of technology in many observations and also speaking about the digital document camera in interviews. A teacher participant emphasized the importance of the document camera by stating:
The use, the use of the document camera is just incredible to me. I never thought I
would use it cause I use the overhead, but it’s so much easier to just pop
something up. Whatever you have at your fingertips, you just throw it under the
document camera. You don’t have to make a copy of it, and it just comes up in
color and it looks exactly the same as what the children will see when they go to
their seats.

Two of the six teachers also spoke about using iPads in the classroom. During
interviews, they both spoke about the iPads but stated that neither had sufficient access to
iPads to benefit large groups of their population. One of the teachers had access to iPads
in previous years, but did not any longer, while the other teacher currently only had
access to two iPads, which was limiting. A teacher participant stated, “We use those
[iPads] as a center for intervention purposes. Math intervention and usually that’s with 2,
sometimes even 3, students to an iPad. They share it because there are 2.”

**Software.** The data showed that all six participants used many different types of
software in the classroom, depending on the students’ grade and type of classroom.
Three of the six participants utilized district purchased subscriptions to software, either
the Lexia Reading Program (utilized by the reading teacher participant) or the FastMath
software.

Another type of software teachers used was software already present on teachers’
computers, such as Powerpoint and, for the three participants with SMART Boards,
Smart Notebook, and the two participants with a MimioBoard, Mimio Studio. Four out
of the five participants with interactive whiteboards (either a SMART Board or a
MimioBoard) utilized the different types of installed computer software in order to create
and show presentations on the interactive whiteboard to students. In an interview, one teacher participant commented:

I put together a SMART Board notebook for every anthology story that had activities that tied into the phonic skill, power points to illustrate the vocabulary because I’m SEI, the ELL inclusion. So I use that just to put the pictures and the words and any other background things that I can put together for them.

The data, both interview data and observational data, also revealed that five out of the six participants utilized CD based software, either purchased by individual teachers or by the school district. The CD based software spanned all subject areas, including math, social studies, reading, writing, and science.

**Websites.** The final type of technology present in five out of the six participants’ classrooms was the use of websites. Teachers utilized websites to demonstrate a skill or concept to students as part of an introduction to a unit or a lesson or as a method for students to review previously learned material. During interviews, teachers mentioned that they utilized websites such as Youtube, Discovery Education, and Brain Pop Jr., to show video clips to introduce or reinforce a concept. Teachers also commented that they utilized websites such as Raz Kids and SpellingCity to track students’ progress and also to allow students to practice concepts and work on individualized levels. Teachers used different types of websites for all different purposes in the classroom: for review, assessment, and as a teaching tool.

**Ways of learning about technology.**

To learn how to use all types of technology, teachers learned through three main avenues: self-teaching, collaboration with colleagues, and district trainings.
**Self-teaching.** The main source of learning about technology that teachers spoke about was through their own self-teaching. All six teacher participants referenced learning through investigating and exploring on their own time and through their own means. All six teacher participants commented on how they spent time outside of school researching different types of technology and how the kinds of technology could be utilized in the classroom. One teacher expressed, “I go to Gizmodo.com; it’s like a gadget type website. So they’ll come up with things, and as a teacher, I’m always thinking of like how could that be used in the classroom?” Another teacher, referencing the use of the MimioBoard stated:

> I taught myself. I didn’t take any classes. I mean I basically teach myself how to.

> That’s why like I feel like with the MimioBoard if I took training or something I could really utilize it a lot more. I mean I only use it the way I know how to use it.

Another teacher participant explained, “It’s just going through the websites and seeing what you can find, and sometimes it’s just, it’s just a new way of thinking.”

One teacher participant commented on learning about technology through a previous job. This participant stated that some knowledge came from a former career.

**Self-motivation.** Teacher participants were self-motivated to explore new facets of technology to utilize in the classroom. When new types of technology came out or new websites, teacher participants often examined these new features on their own. One teacher excitedly relayed an experience of witnessing someone turning a Wii remote into a SMART Board online. Another teacher spoke about using teacher blogs to explore new technologies in education and learn how to transform them to fit into the context of the classroom. One teacher expressed enthusiasm for the Lexia reading program by stating:
Well I’ve known of Lexia since it was created, and I was in another school system, and over the years looked for grant money. Looked towards like how could I get this in my school system. So then when I was here, and I mean, it was just like 2 years ago, I was just like thrilled beyond belief.

Teacher participants were all self-motivated to learn more about technology in order to bring new types of technology into the classroom and to advance their use of technology in the classroom. As a result, through interviews, the data showed that the main source of learning about teaching with technology was through self-teaching, as a direct result of self-motivation.

**Collaboration with colleagues.** Along with self-teaching, collaboration with colleagues was the next most common method of learning about technology. Four of the six teacher participants spoke about collaborating with colleagues to improve their technology integration while teaching. Teacher participants referenced using teacher colleagues who had a greater knowledge base about technology as a resource. When teachers were not sure how to utilize a certain type of technology, they turned to a colleague. One teacher participant stated, “Last year we had a [teacher assistant here]. He was very much into the iPads, so he showed me a lot of the ins and outs of using the iPad.” Another teacher who commented about continuing to learn how to use technology indicated, “I’m still learning… colleagues help a lot. [Another teacher] like really helped me a lot with SMART Board.”

Teacher participants also spoke often about collaborating with colleagues to create documents to share. One teacher stated, “I did collaborate with [one teacher]. She had started some things and then shared them with me. And then I added or she, and we
split it up.” The teacher participant added about collaborating with a different teacher, “She has a degree in technology, and we would share a lot of things too, that we did together.”

Teachers in this study consistently spoke about the value of colleagues, and the helpfulness of sharing ideas with other teachers also using technology on a daily basis.

**District trainings.** Four out of six teacher participants referenced district trainings when asked about how they learned how to utilize technology in the classroom. Three of the four participants who mentioned having attended district trainings to learn about technology also expressed a desire for future district trainings and believed the current district offerings were extremely limited. The majority of teacher participants only had attended a single day training to learn how to use technology and had only learned how to operate the basic functions of the technology (mainly the interactive whiteboards).

**Strategies of teaching with technology.**

Teacher participants had a difficult time describing their methods of teaching with technology. When asked what instructional methods teachers used to teach with technology, most teachers either paused, having to ask for further explanation of the question or went on to explain in detail ways of using technology that were not instructional methods.

For example, when asked the question, one teacher participant responded:

Well, I think the technology makes it easier to do a lot of things. You know, like it’s easier to share student work and to go over student work and see examples of good student work when you can just throw it up under the document camera.
This teacher participant utilized the same instructional methods when teaching with and without technology, but commented that technology made it a lot easier to teach. Another teacher participant, when asked about the instructional methods used in the classroom, began describing the different types of groupings utilized with students when teaching with technology. No teacher participants clearly described the instructional methods they utilized when teaching because, as the data showed, teacher participants did not see a difference between how they taught with technology and how they taught without technology.

Teachers did not view technology as transforming the methods of their teaching but rather enhancing their teaching. One teacher reflected, “All I had to do was go to the SMART Board and get some more information off the Internet to help enhance my teaching, I think. So I think it just enhances everything that you do.” Teachers viewed technology as a tool that made it easier to teach more effectively, but did not change or transform the way they were teaching. Another teacher participant revealed, “I just find that it, there’s so much more at your fingertips with technology and the Internet and United Streaming and all those great resources that it’s easier to incorporate best practices with technology than it is without.”

Along with similar instructional strategies, teachers utilized the same grouping patterns for students when they taught with and without technology.

**Grouping of students during lessons.** Teachers did not believe that a certain type of grouping method was preferable to teaching with technology, but rather felt that certain types of technology lent themselves better to specific methods of grouping of students.
When teachers utilized technology that emphasized the visual aspect of a lesson, through the SMART Board, the MimioBoard or the digital document camera, the teachers often believed that the lesson was better suited to whole group lessons. The interactive whiteboards and the digital document camera allowed all students to see the content and also gave teachers the capability to utilize realistic graphics and videos to enhance lessons for the whole class. Teachers believed that the interactive whiteboards and the digital document camera were beneficial for whole group lessons because they facilitated larger and more realistic representations of content for all students. Teachers remarked frequently that they employed the digital document camera to show directions to students, show examples of writing, or to show manipulatives to the whole class. One teacher stated:

I use the document camera all the time because I can just put manipulatives like the overhead. You know I use the manipulatives under the document camera to project up on the screen so they can see what I’m doing. I use the document camera to model and go over the directions of the student workbooks… I use it for writing too. I throw rough drafts up there all the time.

Teachers also remarked that the interactive whiteboards were also useful when grouping students in smaller groups because it allowed students to participate with the whiteboard more frequently. After observing a lesson where students played an interactive whole class game on the IWB, the teacher commented that the game works much better in small groups because students are able to participate more frequently and are able to gain more practice on the intended concepts. When the activity on the
interactive whiteboards was more conducive to interaction, teachers were more apt to use small groups to allow for increased participation.

Another method to use technology in a smaller group was to use rotating groups in the classroom while using technology with at least one of the rotating groups. During one lesson observation, one teacher utilized the SMART Board with half of the class, while another teacher worked with the other half of the class on a separate activity, switching halfway throughout the class period. Having a smaller group at the SMART Board allowed for greater participation between students and increased conversation between peers.

Other types of technology, such as computers and iPads lent themselves to either independent work or partner work because of the type of technology. When teachers utilized computers, they had students work independently, either in the computer lab where each student had his/her own computer or during center time where only certain groups of students were on the computers. In classrooms where the iPads were present, students worked in pairs on the iPads, collaborating on games. Since both types of technology are small, teachers believed they were better suited for independent or partner grouping. In an observation of students during a math intervention time, all students at the computer were working independently, and there were three pairs of students working on iPads. In three different observations of three different classrooms in the computer lab, all students were working individually at separate computers. One teacher even told a student to please stop talking to the person next to her because time in the computer lab was meant to be quiet, independent time.
Teachers, overall, did not believe technology changed their grouping practices. They still felt that they grouped students in similar ways to lessons taught without technology. However, teachers did feel that certain types of technology were more beneficial with certain types of student groups.

**Purpose of lesson with technology.** Teacher participants also believed that integrating technology served different purposes depending on when and how the technology was utilized in the lesson. Some of the different purposes were for teaching content, reviewing content or reinforcement of content, or for assessment.

Teachers in this study believed that many of their lessons with technology were classified as teaching with technology in order to teach lesson content. To teach lesson content through technology, teacher participants believed they utilized technology to enhance lessons by providing improved visuals and graphics that facilitated a deeper understanding of content for students. A teacher participant noted, “We’re incorporating like small clips or videos to enhance the lessons for them to see in a different way.” A different teacher reflected:

Like with kids learning how to do subtraction with re-grouping. We’re also going to be starting fractions this week, so I go to use a site called NLVM, a virtual manipulative site. It actually will bring up a subtraction problem and show them in real-time how when you trade a ten for 10 ones, it actually breaks the ten apart into the 10 ones, so it’s very visual for them…. They can actually go up there and they can make equivalent fractions on a SMART Board. It really gets them to compare one to the other; it’s colorful. It’s very visual, and they’re doing it themselves, so it really does help them understand what equivalent fractions are.
Teachers utilized different types of technology, most frequently, the SMART Board, the MimioBoard, and the digital document camera to teach content to students. Five out of six teacher participants used both an interactive whiteboard and a digital document camera to teach content material to students. Teacher participants taught through a variety of methods, through self-made PowerPoint presentations, presentations found on websites online, videos on various websites, and by utilizing pages from student workbooks.

Teachers in this study also believed that utilizing technology for review and reinforcement was important and worthwhile. One teacher stated, “We’re doing weather now, so as a culminating activity, I have a SMART Board lesson, a jeopardy SMART Board lesson, that we’re going to review everything that they’ve learned in weather.” Another teacher articulated:

In math for review we do math games online, so we can project it and we’ll split into teams… we do a lot of that, especially when we’re reviewing for tests. And I do a lot of technology for review.

CD based software was frequently utilized as a review of previously taught concepts. One participant utilized a fraction game titled “Climb the Cliff” to complete a review on their unit of study on fractions. A different participant utilized a CD called “My First Amazing World Explorer” for students to review the continents they had previously discussed in the classroom.

This group of teachers felt that technology provided different ways for students to review content and allowed them to become more comfortable with content they had already learned.
A final purpose of using technology in lessons was for assessment. Some teacher participants believed that utilizing technology as a form of assessment was beneficial. One teacher participant spoke about believing that utilizing technology to assess students’ abilities makes it easier to help struggling students and provide more support to students who need help. When observing a classroom with some students working on FastMath, the teacher participant commented on the ease of tracking the math facts each student was having difficulty with from the teacher assessment page. Teachers in this study felt that utilizing technology to assist with assessment of students’ strengths and weaknesses allowed teachers to better monitor students and better help students.

**Technology in differing content areas.**

Five out of the six participants used technology in various content areas. Teachers in this study believed certain content areas had a better fit with technology than other content areas, but the specific content areas depended on the teacher’s opinion and familiarity with the type of technology and the type of activity.

**Teacher expertise with technology.** Teachers in this study had different experiences with the various types of technologies and, therefore, had different comfort levels with and preference towards certain types of technology. The teacher’s preference and expertise with the content area and the familiarity with the type of technology influenced how the teacher utilized the technology during certain content areas.

During interviews, teacher participants spoke about their preferences for certain types of technology. Certain teachers, while they may have had access to the same technology as other teacher participants, relied on other types of technology more frequently depending on their preference and comfort level with the technology. One
teacher participant who spoke about utilizing the digital document camera frequently stated:

Like all of a sudden, I realized that there were things you could do with the document camera that you really couldn’t do with the overhead because everything was projected in color. And true to life, that then I couldn’t live without the document camera.

This teacher participant spoke about experimenting with it often and trying out different objects under it and eventually incorporating it into daily lessons. However, other teacher participants with access to the digital document camera did not use it during several lessons and did not speak about it with as much passion or frequency in interviews.

In contrast, other teachers preferred other types of technology in the classroom. One teacher spoke about the MimioBoard and about how it was a great tool for allowing students to learn. The teacher participant acknowledged:

I use the MimioBoard for, like a lot of the things that I would do on chart paper, I use presentations on the MimioBoard… and it’s easy…. It’s like basically like an overhead, but it’s on the projection. So it’s just, I don’t know. It’s easier; it’s more accessible.

A different teacher participant instead commented on utilizing the SMART Board. The teacher participant articulated, “The main thing I use most of the time, I think, is the SMART Board. I use it to, I use it all throughout the day.” This participant then described all of the different ways to utilize the SMART Board to enhance reading instruction, including building vocabulary through graphics and video clips, practicing
high frequency words on the SMART Board, and practicing comprehension skills such as sequencing using the SMART Board. In the classroom where the teacher spoke about a deep belief in the benefits of the Lexia reading program, students filled every computer during lesson observations from the start of the lesson until the very end.

Teacher preference and knowledge of how to utilize certain types of technology affected the types of technology teachers utilized in content areas.

**Fit of technology and content area.** Five of the six teacher participants were elementary classroom teachers, with these participants teaching all general education subjects to students (reading, writing, math, science, and social studies). One teacher participant was a reading specialist, therefore, only teaching reading and writing to students. Some of the classroom teachers in this study expressed their beliefs that certain types of technology had a better fit with certain content areas, and, therefore, used technology more frequently in certain content areas.

Some teacher participants utilized technology in all content areas they taught, while others integrated technology more frequently in select content areas. One teacher who used it mostly for math stated, “it’s mostly math that we use it [technology] in. I would say, you know, if there’s 10 lessons out of every day math, I would say about 5 of those would have like a Mimio component to it.” Another teacher participant spoke about utilizing technology during social studies frequently because it allowed more students to access the curriculum. This participant believed that technology enhanced the participation of all students in social studies and demonstrated concepts more vividly than in other content areas.
Conversely, some teacher participants spoke about using technology to teach almost all, if not all, content areas. One teacher asserted, “We use it for almost everything we teach; there is some kind of component where we put technology with it.” Some teachers did not differentiate between the content areas and technology use and spoke about utilizing technology throughout the day in all content areas. One teacher, when asked about using technology in lessons, spoke about using it during reading all the time, in math all day long, in writing frequently, in social studies often, and in science when able to acclimate to the new first grade curriculum.

**Fit of technology and activity.** Teachers in this study also varied how they utilized the technology depending on the fit of the technology and the activity. Some teacher participants spoke about how some activities “call themselves” to use a certain type of technology. Teacher participants spoke about the fit of different types of activities and different types of technology during interviews. Through observations, the data showed that some teacher participants utilized certain types of technology in similar activities frequently.

During observations, teacher participants utilized the digital document reader to demonstrate directions for either workbook pages for math or for reading. Teacher participants employed the digital document reader as a quick way to go over directions for assignments for students before they began work independently. One teacher participant conveyed:

I have it [digital document camera] hooked up to my computer and it projects right on the SMART Board. When I want to do a paper or go over directions, it’s pretty easy to just pull that out and show it up on the SMART Board.
Observations showed that interactive whiteboards were utilized more as a teaching tool where the teacher would demonstrate concepts and teach new concepts and reinforce already learned concepts on premade presentations in various content areas. Teachers also commented in interviews that they utilized interactive whiteboards when they needed to demonstrate a visual concept, where the interactive whiteboard would assist in allowing students to visualize abstract ideas. One teacher spoke about utilizing the interactive whiteboard for activities when, “it’s more using manipulatives, using the white board to get up and move things around and see how things work together and sort them out.”

Teacher participants utilized technology differently based upon the activity they were planning to integrate. Teachers believed that certain types of activities were better suited to some types of technology more so than others.

**Incorporation of 21st Century Skills**

The third theme that emerged from the data was the incorporation of 21st century skills. Teachers in this study had limited knowledge of 21st century skills and, therefore, were unsure about how to incorporate these skills into lessons with technology, with the exception of communication and collaboration, which, in some cases, was facilitated by technology.

**Limited knowledge of 21st century skills.**

Three of the six teacher participants had never heard of 21st century skills and needed additional clarification during interviews regarding the definition of these skills. The following definition was provided to teachers: 21st century skills are problem solving and critical thinking, collaboration and communication, and innovation and creativity. All
of these skills are essential, in conjunction with technology and core subjects, for students to be successful in current and future complex work environments (Partnership for 21st Century Skills, 2009). Following this definition, teacher participants were then able to give varied examples of ways they utilized 21st century skills during lessons with technology.

**Limited forethought and planning.**

The other three teachers knew the basics of 21st century skills but were unsure of how to translate their knowledge of the isolated skills into fully developed lessons that included content, technology, and 21st century skills. One of the teachers stated, “I’m not quite sure how I would incorporate [21st century skills], you know, [with] the use of technology…. I definitely need some time to kind of review and really process how that would work with the children.”

When 21st century skills were incorporated, teachers in this study addressed them with limited foresight and planning and often without fully developing the opportunities for students to practice these skills. Lessons with technology were not always planned with 21st century skills in mind and were not often planned with the forethought of improving students’ use of 21st century skills, but rather the skills were embedded randomly in lessons.

**Integrating content and 21st century skills.** Teachers in this study were unsure of how to plan lessons that addressed 21st century skills, while also covering the state standards.

**Creativity and innovation.** During interviews, many teacher participants remarked that they would like to incorporate more 21st century skills, but felt constrained by the
amount of content they had to teach. Five of the six teacher participants remarked that they would incorporate more creativity in their classrooms if they had more time. The teachers in this study commented that they used to be able to infuse more innovation into their classroom, but with the increasing amount of content they had to teach, they had to discontinue many of their creative projects. One teacher confirmed:

I used to do a lot more with creativity, and I think time has become less and less each year. I used to do a lot of… I’m thinking of a story that I used to read with them, a dinosaur named after me. We would have a template in Kid Pix and then they would create a dinosaur and then they would name it after themselves and write stories about it. I really wish I had more time to do some of that stuff, but our day is just so packed now, it’s really hard to get it in there.

During observations, there was little evidence of creativity and innovation. Lessons were very structured and were teacher driven, with very limited time for students to explore technology on their own and to be innovative. During a writers’ workshop lesson, two students worked on a computer creating a cover for a book they had written. The teacher spoke about wanting to have students do more creating like this, especially since it is required in the Massachusetts Frameworks, but currently did not have much time in lessons for it.

All teachers relayed their desire, through interviews, to increase the amount of creativity and innovation in the classroom, but felt constrained by the amount of content they were required to teach and the lack of time they had in the day. Teachers in this study were unsure about how to incorporate and plan for creativity and innovation into their teaching, while also meeting all the state and federal requirements.
**Problem solving and critical thinking.** During interviews with all six teacher participants, teachers spoke about incorporating critical thinking and problem solving in lessons with technology. One teacher explained a technology lesson and how it enhanced students’ critical thinking:

They go to different websites, it’s kind of like a quest on the web… they definitely have to use their critical thinking there because they not only need to like, you know, pick their answers but also why… so I definitely think that it enhances their critical thinking in those areas.

Another teacher, in speaking about the Lexia reading program, affirmed the use of problem solving with technology, “it [Lexia] really is empowering the students, you know, to, to be, you know, thinking for themselves. Problem solving.”

All six teacher participants expressed their beliefs in interviews that problem solving and critical thinking were embedded in their lessons in technology. During lesson observations, there were instances of critical thinking and problem solving, although many of the opportunities for problem solving and critical thinking were not fully developed and were not planned to maximize student learning. When teachers in this study asked questions meant to stimulate students’ critical thinking, the teachers asked students to give rationales for their answer, but then the teacher would move on to the next question without giving the students ample time to process the question.

For example, in a math lesson on division, students were trying to establish the link between multiplication and division by pretending the division key was broken on their calculator and solving division problems by using the multiplication key instead.
While some students understood this connection quickly, other students had difficulty, and the lesson moved on before they were able to make the connection.

In a social studies lesson, the teacher participant asked students why the astronauts would have wanted to leave an American flag on the moon. The students began to start thinking, but before they could fully develop their rationale and expand upon their critical thinking, the teacher moved on to the next section of the lesson.

During many observations, lessons with opportunities for critical thinking and problem solving were present, but not all students were engaged and involved in the process. The teacher participants did not seem to provide ample time for all students to engage in deep and meaningful critical thinking and problem solving opportunities. The lessons were not planned with the idea of fully capitalizing on students’ use of 21st century skills to prepare them for their later lives in school and in society.

**Effect of specific content area.** Because of teachers’ limited understanding of 21st century skills and difficulty incorporating content information with 21st century skills, the content area did not have any effect on the degree of incorporation of 21st century skills. In all content areas when 21st century skills were present, they were often not fully developed and were integrated with limited forethought on how the skills translated to students’ future academic careers.

In all content areas, teachers incorporated technology and 21st century skills in similar ways. In interviews, teachers spoke about creativity and innovation, but these skills were rarely witnessed in observations, regardless of content area. In all content areas, the type of technology dictated the amount of collaboration and communication, rather than the specific content. If students were utilizing an interactive whiteboard or an
iPad, collaboration and communication were increased in all content areas, however, if students were on individual computers, collaboration and communication were decreased. Problem solving and critical thinking occurred in all content areas, although the opportunities for students to participate were limited and were not expanded upon.

**Influence of technology on 21st century skills.**

Twenty-first century skills were not always fully addressed in lessons with technology, however, some types of technology enhanced communication and collaboration. Depending on the type of technology being utilized, the incorporation of communication and collaboration was assisted by technology.

**Technology facilitating collaboration and communication.** The visual nature of many of the types of technology, in particular the interactive whiteboards and the digital document reader, enabled students to read and see common classroom content and work on problems together. In one lesson, the SMART Board facilitated collaboration during a Jeopardy game. While only one group leader was able to interact with the SMART Board, the rest of the group was able to read the question or see the visual associated with the question and, therefore, was able to participate in helping to answer the question. The SMART Board allowed all members of the group to work together to solve the problem as a collaborative group.

Additionally, iPads and other types of interactive whiteboards permitted small groups of two to three students to work together easily. With both iPads and interactive whiteboards, students worked collaboratively and communicated with ease utilizing technology. When asked about working with these types of technology, students remarked that they enjoyed collaborating with each other. In a lesson where students
worked in pairs on an iPad, the students were able to both participate because of the mobile nature of the iPad and the ability to move the iPad between the students, so both students could read and participate in the math game. The iPad also facilitated collaboration because students were motivated by the highly engaging games available on the iPad.

**Technology inhibiting collaboration and communication.** Some types of technology did not facilitate collaboration and communication and, in fact, inhibited communication and collaboration. In particular, computers inhibited communication and collaboration between students. One teacher commented on the differences between the collaboration with different types of technology:

Since the technology that we have here, it doesn’t really lend itself a lot to group work unless it’s, you know, a SMART Board lesson and they’re talking in their groups about it…. Last year when we had the iPads, it would be easy because like 3 or 4 people could be working on one, but now to put 3 or 4 people on a computer, it’s kind of hard, you know, for them to talk about something like that because there’s just not the room. But in the past I’ve done it. I just haven’t done a lot this year because the technology that I have that I feel doesn’t really lend itself to that.

Computers made communication and collaboration between students difficult because of the individual nature of computers. The computers in the classrooms were all desktop computers and not mobile, making it difficult for students to share information. The computers, whether in the students’ classrooms or in the computer lab, were placed closely together, so students had a difficult time sitting next to each other at a computer.
In every lesson observation where computers were utilized, students were expected to work individually and engaged in activities not designed to promote collaboration or communication. One teacher when speaking about a computer software program for the computers stated, “When they do fast math, that’s to increase their own individual fact power. That’s really not meant to be collaborative.” These lessons utilizing technology inhibited collaboration and communication.

**Conclusion**

Through analysis and coding of interview data, lesson observations, teachers’ TSATs, and background information, three main themes emerged which described how teachers integrated technology in elementary classrooms and how teachers addressed 21st century skills with the incorporation of technology. The data showed that teachers in this study believed in numerous benefits of technology use in the classroom, including the ability to increase student and teacher motivation, provide lessons with more relevance to students’ lives, enable greater accessibility to enhanced resources, and improve teacher instruction. Secondly, the data demonstrated that different types of technology had a variety of uses in the classrooms throughout all content areas. Teachers in this study utilized a variety of types of technology with various grouping methods for differing purposes, such as introduction, review, and assessment. Finally, the data showed that teachers in this study incorporated most 21st century skills with limited forethought and planning due to the teachers’ basic knowledge of these skills. However, the data demonstrated that technology facilitated communication and collaboration in lessons.
Chapter V: Discussion of Research Findings

Technology continues to shape the world around us, changing daily life. Schools must adapt to prepare students for the changes reflective of the outside world, including the distinctive technological culture in which students now live and thrive in. Many schools and teachers have not adapted to this change and have not fully embraced technology and the potential for improving teaching and learning through teaching with technology. In particular, there is a lack of knowledge regarding the most effective methods of teaching with technology. The majority of research concerning integrating technology in the classroom has been centered upon middle school and high school classrooms. However, elementary students have distinctive needs, unique from middle school and high school students, requiring a different approach to teaching with technology in the classroom.

Through the lens of Vygotsky’s (1978) socio-cultural theory and online learning theory, this study described the different ways that elementary teachers integrated technology into their classrooms and addressed 21st century skills while utilizing technology. Online learning theory emphasizes the importance of education reflecting the digital age; illustrating ways technology can be utilized during lessons to prepare students for the current society (Ally, 2008). Equipping students for today’s society includes incorporating 21st century skills in daily lessons. Similarly, Vygotsky’s (1978) socio-cultural theory emphasizes the importance of connecting learning experiences to authentic life situations, as is the goal with incorporating 21st century skills. Vygotsky’s (1978) socio-cultural theory emphasizes student learning through 21st century skills such as collaboration and communication. Through collaboration and communication, peers
and technology can both act as more knowledgeable others (MKOs), enabling students to further their learning by working in their zone of proximal development (ZPD).

The findings showed both teachers and students alike believed in the positive benefits of technology use in the classroom. The findings also demonstrated that teachers integrated technology utilizing various grouping methods and instructional practices depending on the content and lesson. Both the grouping methods and the instructional practices were comparable when teachers taught without technology. The findings also indicated that teachers had limited knowledge of 21st century skills and, therefore, did not address 21st century skills with sufficient planning and forethought. However, students’ communication and collaboration was facilitated by the use of certain types of technology. These findings provide the foundation for specific recommendations for professional development to transform lessons taught with technology, along with providing teachers with more information on 21st century skills and how to better equip elementary students with the skills needed to succeed in later education.

Benefits of Technology

Benefits for students.

*Increased motivation and engagement.* There are many potential benefits associated with utilizing technology educationally, depending on how technology is integrated into the classroom. In a study of 21 kindergarten and first grade students, Ching et al. (2006) found that implementing digital cameras into lessons resulted in students becoming more engaged in their work. In another study, Chang et al. (2010) demonstrated that virtual learning increased students’ motivation and improved student learning when compared to traditional lessons without technology. Furthermore, in a
study of 11 first grade classrooms, both teachers and students affirmed that technology increased student levels of engagement and excitement with learning (Blachowicz, Bates, & Berne, 2009). Throughout the literature, studies reported increased levels of engagement and motivation among students when utilizing technology.

Similarly, in this study, teachers and students alike relayed their beliefs that students experienced increased motivation when learning with technology. This study highlights the relationship between technology integration and student engagement. Finn & Rock (1997) defined student engagement by three levels. In level 1, students’ engagement is determined by how students follow the rules and behaviors of school. In level 2, students’ engagement is composed of how much initiative a student takes to encourage dialogue and ask questions. In level 3, students’ engagement is described by a student’s participation in social, athletic, or other extracurricular activities (Finn & Rock, 1997). Fredricks, Blumenfeld, & Paris (2004) defined student engagement by the different dimensions of student behavior: behavioral engagement, emotional engagement, and cognitive engagement. Finn & Rock (1997) and Fredricks et al., (2004) believe that the different components of student engagement can be manipulated by teachers and the school environment to increase student engagement. By increasing student engagement, student outcomes can be affected in a positive way (Finn & Rock, 1997: Fredricks et al., 2004). In this study, teachers and students also reported their beliefs that an increase of motivation and engagement enabled students to remain more focused during lessons, resulting in students learning and absorbing more content.

Differential motivation based on type of technology and degree of participation.

Additionally, in this study, the data showed that the type of technology and the degree of
student participation affected student motivation and engagement. While studies in the research demonstrated how implementation of technology affects student learning, in the literature reviewed, the effect of the type of technology and degree of participation on student motivation and engagement were not a primary focus.

In this study, students were more highly motivated by iPads than by computers and were motivated by the IWB differently depending on the content it showed and how it was used. The better the graphics and the more participation the technology allowed, the more motivated and engaged students were. The newest types of technology with the latest graphics more closely mirror what students are used to seeing at home. Vygotsky’s socio-cultural theory states that cultural tools reflect the beliefs of a society and also affect thinking. Technology can be thought of as a cultural tool that influences students’ thinking (Miller, 2011). Online learning theory suggests that schools must update to reflect the constantly changing world (Ally, 2008). Both theories illustrate the idea that technologies which more closely replicate what occurs in society will allow students to better participate in society. Older games on the computer with outdated graphics do not sustain young students’ attention since they have grown up in the digital world and are accustomed to more interesting and exciting graphics.

Furthermore, the technologies that increased collaboration also improved students’ motivation. In activities with iPads and small group activities on the IWBs, students were able to collaborate with each other more easily than activities on the computer or in large group IWB lessons. Vygotsky’s socio-cultural theory emphasizes that learning with others can increase student learning (Vygotsky, 1978).
**Improved instruction.** Along with an increase of motivation and engagement, many studies also demonstrated how technology in the classroom allowed teachers to improve their instruction through increased differentiation, enhanced methods of monitoring student learning, and by greater flexibility with teaching. In a study comparing a technology-based intervention and a traditional instructional intervention, the technology-based intervention had a greater effect on at-risk students (Neill & Mathews, 2009). In another study comparing two schools implementing the same software program, the school that utilized the progress monitoring tools on the software experienced higher gains in students’ academic achievement when utilizing the software to differentiate instruction and target students’ weaknesses (Mean, 2008). Moreover, in a study of 11 urban, high-risk first grade classrooms, teachers had more flexibility to help struggling students because other students became more independent when utilizing technology (Blachowicz, Bates, & Berne, 2009).

Similarly, in this study, teachers reported that technology improved their own instruction. Teachers in this study described their increased ability to monitor students’ growth with the help of technology. Teacher participants believed that many types of software and websites enabled them to better track students’ strengths and weaknesses and allowed them to build upon their weaknesses more easily. Furthermore, teachers communicated their belief that technology provided teachers with more time to help struggling students.

Because of the technology, students in this study were able to work more independently. Much of the technology explained concepts and provided clarification if students were not understanding or completing tasks incorrectly. Instead of the teacher
having to step in frequently, the students in this study worked more independently, and, as a result, the teacher was able to assist other students.

Vygotsky’s socio-cultural theory states that students can learn at a higher level when being guided by a more knowledgeable other (MKO), thus allowing students to work in their zone of proximal development (ZPD) (Miller, 2011). For example, students listened to books on the computer at a higher reading level than they would be able to read on their own because the computer either read the story to them or read unknown words, providing scaffolding to the students. The technology acted as a student’s MKO in many instances, allowing students to work at a higher level than they would be able to otherwise.

**Benefits for teachers.**

A benefit of technology discussed by teachers in this study, but not present in the literature centered on the benefits of technology directly affecting teachers. The benefits of technology in the literature focused on the benefits to students that are associated with technology, such as increased motivation and engagement, improved teacher instruction, and increased differentiation. However, in this study, benefits directly associated with the teacher were also present. Teachers spoke about their own increased motivation and engagement when teaching lessons with technology. Teachers also commented that technology made their lives easier by providing more accessible resources, easier ways to store lessons, and, for some participants, methods for creating lessons that were less time consuming. The literature focused more on how students benefited from technology use, while the teacher benefits were also widespread in this study.
Prevalence of Technology

There are many different types of technology being used educationally for a variety of purposes in the classroom. The United States has spent billions of dollars on technology in education over the past 10 years (Lei, 2010). Schools have also committed to an increase of technology, by offering more opportunities for teachers to learn about how to capitalize on new technology in the classroom. Ninety-five percent of school districts throughout the nation have provided professional development on classroom technology integration (Educational Technology in Public School Districts, 2008). Furthermore, in Massachusetts, 81% of teachers report that they utilize technology during teaching at least once a week (Massachusetts Department of Elementary and Secondary Education, 2011b).

This study also demonstrated the prevalence of technology in education. Five of the six teachers in this study housed between 4-6 computers, an interactive whiteboard (either a Mimio Board or a SMART Board), and a digital document camera. One of the teachers also had iPads. The teachers in this study had many different types of technology, which they utilized frequently. Five of the six teacher participants utilized technology in more than one content area, and all teachers in this study stated that they used technology daily.

Similar Teaching Strategies With and Without Technology

To utilize the various types of technology and to realize the potential benefits of teaching with technology, teachers need to know how to utilize technology effectively. Integrating technology into the classroom must be done carefully, with regard to not only the technology but all areas of effective teaching, including content, pedagogy, and
context of the classroom (Harris, Mishra & Koehler, 2009). Technology use in the classroom needs to be structured around well-planned activities (Tolentine et al., 2009). However, many teachers are unaware of different ways to effectively integrate technology into the classroom and, instead, attempt to use technology without clear guidelines on how to do so (Kop & Hill, 2008). Much research in the literature suggests that teachers need to utilize current learning models, along with new, updated learning strategies that reflect the digital age (Ally, 2008; Strudler, 2010).

In this study, however, teachers received limited training on how to utilize technology in the classroom, with most participants stating they only had a one-day district training on utilizing technology educationally. Most of the teachers’ knowledge about technology came from self-teaching or through collaboration with colleagues, who were also mostly self-taught. While teachers knew how to operate technology and explored different resources to utilize in the classroom through their own research, teachers did not change or update their teaching practices and, instead, taught with technology in similar ways they taught without technology. Their instructional practices with technology were not transformed, necessary through the lens of online learning theory to effectively educate students in the current, digital age (Ally, 2008).

**Importance of updating teaching strategies to reflect digital age.**

Scholars in favor of the online learning approach, argue that teaching with technology should be adjusted to reflect the changing world and should be approached in a different way than teaching with traditional methods where the teacher transmits information to students (Ally, 2008). However, as teachers in this study described learning how to utilize new types of technology through the Internet, blogs, and
colleagues, they spoke about learning about new technology and how to use it; they did not talk about how to incorporate this technology into their lessons. Because teachers were mainly self-taught, they have not engaged in the types of conversations necessary to modify their instructional practices; therefore, they have not altered their teaching practices even as they incorporate technology during daily lessons.

In the literature, different instructional strategies were utilized to teach with technology. Problem-based learning is one strategy of teaching with technology that can update lessons to be more reflective of today’s global society (Sungur & Tekkaya, 2006). Additionally, strategies such as multi-user virtual environments (MUVEs) and Situated Multimedia Arts Learning Labs (SMALLabs) are utilized to transform teaching to include the use of technology (Dede, 2007; Tolentino et al., 2009).

In this study, teachers were not aware of the pedagogical strategies mentioned in the literature, and, instead, employed different methods of grouping and incorporated technology for differing purposes at various points in their lessons to teach with technology, much in the same way they taught lessons without using technology. Teachers in this study utilized technology as a part of a lesson, either to introduce or teach content, review previously learned content, or to assess student learning. Depending on the purpose of the lesson, the activity, and type of technology being utilized, teachers employed grouping practices they felt were most appropriate. Technology was viewed as an add-on by teachers in this study and was not taken into account when planning the structure of the lesson or the instructional practices utilized in the lesson. Therefore, technology did not transform the instructional practices or change
them in any way, but simply took the place of a traditional activity or method of teaching content.

**Technology use in different content areas.**

In the research about technology integration, little reference was made describing how teachers modified technology use depending on the content area. Some studies gave examples of how to use technology in a specific content area, such as a MUVE designed to improve students’ writing or a MUVE based upon the science standards to target science content (Dede, 2007). However, the research did not address teachers who taught multiple content areas, such as elementary teachers, and how these teachers integrated technology in different ways in various content areas.

In this study, five out of the six teachers taught all main content areas. Some teachers incorporated technology during all content areas, while some teachers incorporated technology more into certain content areas than others. Some teachers in this study felt that specific content areas had a better fit with technology; therefore, they incorporated technology more in certain content areas. The integration of technology and content area was different in each classroom and depended on teachers’ familiarity with the different types of technology, with some teachers having preferences for certain types of technology and, consequently, utilizing these types of technology more frequently. Teachers also integrated technology into specific lessons, depending on the activity students were engaged in and whether technology could be incorporated with the activity.

**Basic Incorporation of 21st Century Skills**

As the importance of 21st century skills continues to grow, many employers have begun to require that prospective employees demonstrate them because of their relevance
to success in today’s more complex jobs. Menial jobs are being replaced by technology or are taken overseas, and many available jobs are requiring a more intricate skill set. Knowing the basics of reading, writing, and math is no longer sufficient for today’s workforce. Many jobs now also require that employees have solid science and technology backgrounds and have a good base of 21st century skills (American Management Association, 2010).

In order to be prepared for the changing workforce, schools must begin to introduce 21st century skills at a young age. The Massachusetts Common Core Standards introduces 21st century skills beginning in kindergarten, with standards targeting communication and collaboration, problem solving and critical thinking, and technological literacy. Each subsequent year, teachers are required to build upon the complexity of these skills. Therefore, for students to be successful in later education, teachers need to emphasize and promote these skills at a younger age (Massachusetts Department of Elementary & Secondary Education, 2011a). Furthermore, many of the fastest growing occupations in the country are related to STEM (science, technology, engineering, and math) subjects. For students to pursue STEM related fields, they will need to be successful in STEM subjects in middle school and secondary school. By preparing students with the skills necessary to succeed in these subjects at an early age, teachers are providing students with more options for future career paths (Vaidyanathan, 2012).

In this study, teachers had limited understanding of how to implement 21st century skills into the elementary curriculum and, therefore, were unsure of how to adequately provide students with the skills to be successful in later education and in the workforce.
Teachers spoke about needing more information regarding 21st century skills and how to address them in lessons. Because of their uncertainty with 21st century skills, teachers in this study did not plan lessons with these skills in mind. When opportunities for incorporation of 21st century skills arose, teachers did not fully develop these opportunities and did not allow sufficient time in the lesson for all students to engage with the 21st century skills. Teachers in this study were more focused on the content of the lesson, rather than balancing the content with 21st century skills and allowing students sufficient time to focus on 21st century skills. Teachers described the increasing amount of content necessary to teach on a daily basis and how this pressure constrained their teaching.

Additionally, because of teachers’ basic understanding of 21st century skills, teachers in this study had difficulty creating lessons aimed at improving students’ use of 21st century skills. Even the three teachers who had more familiarity with 21st century skills spoke about the difficulty of incorporating the skills with the existing curriculum. They needed guidance to construct more effective lessons for students that incorporated 21st century skills and better prepare students.

**Balancing content and incorporation of 21st century skills.**

Teachers in this study conveyed their frustration with the large amount of content to teach and their limited time. Teacher participants stated that they were not able to promote creativity and innovation in lessons because of time constraints. Through observations, teachers also demonstrated their limited time for expanding upon problem solving and critical thinking opportunities. Through the research, many of the ways to
include content, 21st century skills, and technology require that teachers transform lessons by utilizing updated instructional strategies.

**Strategies facilitating incorporation of content and 21st century skills.** Online learning theory suggests that instructional practices must be modified in order to fit with technology. Teaching should not be approached in the same way when technology is utilized (Ally, 2008). To effectively incorporate 21st century skills with technology and classroom content, different instructional methods can assist teachers with the integration of all areas, enabling teachers to teach content and 21st century skills effectively and efficiently. Utilizing instructional methods such as problem-based learning (PBL) or incorporating MUVEs facilitates teaching both content and 21st century skills (Dede, 2007; Sungur & Tekkaya, 2006). In PBL, groups of students collaborate to problem solve a complex problem-based on classroom content (Sungur & Tekkaya, 2006). Similarly, with MUVEs, students work with a multifaceted problem-based on classroom content. Students work through an avatar, with the MUVEs designed to allowed students to work collaboratively, often virtually mirroring many of the common practices in jobs today (Dede, 2007). Through these types of problem solving, students are exposed to all 21st century skills, while also learning classroom content.

Through the lens of Vygotsky’s socio-cultural approach, technology can be seen as a cultural tool. The context of a classroom and the activities within the classroom should contain significance in students’ lives. In order to increase the significance of the context of today’s classrooms, the realities of students’ everyday lives and future lives need to be reflected in the classroom. Vygotsky (1978) supposed, “Writing should be incorporated into a task that is necessary and relevant for life” (p.118). Twenty-first
21st century skills are composed of skills students will need to be successful in society. However, to integrate technology and 21st century skills, teachers’ instruction needs to be transformed to assist in the integration of content, technology, and 21st century skills.

**Increased Collaboration, Communication, and Active Learning**

**Collaboration and communication.**

In this study, the strongest aspect of 21st century skills in most classrooms was communication and collaboration. Some of the types of technology present in the classroom facilitated students in collaborating with peers and communicating more frequently and more effectively than in traditional lessons without technology. In particular, the interactive whiteboards and iPads allowed students to collaborate easily when working in small groups. The instructional strategies that teachers employed with the interactive whiteboards and iPads were also conducive to strengthening 21st century skills and allowed students the opportunity to enhance their collaborative and communicative skills.

In the literature, the research also suggested that small group work on the IWB increased collaboration between group members (Mercer, Warwick, Kershner, & Staarman, 2010). Small group work on the IWB promoted communication between students and increased pedagogical interactivity, students interacting with the teacher and with peers. In this study, in classrooms where interactive whiteboards were utilized, collaboration between students was increased, in particular when the size of the group utilizing the interactive whiteboard was decreased because it provided group members with more opportunities to participate (Blau, 2011).
Active learning.

In Vygotsky’s socio-cultural theory, active learning is an essential component of student learning. Increased participation is therefore an integral component, as participation enhances active learning (Miller, 2011). Furthermore, interacting with others is a necessary step before students can translate learning to the individual level (Vygotsky, 1978). Large group lessons with technology need to be balanced with individual and small group work in order to allow students to work within their zone of proximal development (Blau, 2011). In this study, some teacher participants utilized the interactive whiteboard and iPads to facilitate small group work. However, active learning with high levels of participation was only present in certain lessons with specific types of technology and was not widespread across all lessons.

Summary of Findings

The analysis of all data revealed that while teachers and students in the elementary schools in a school district in Central Massachusetts believe in the advantages of technology integration in the classroom for a variety of reasons, teachers still utilized the same methods of teaching when integrating technology as they do in traditional, teacher directed lessons without technology. Furthermore, teachers had a basic understanding of 21st century skills and were unsure of how to integrate these skills into lessons, while also covering required content. Overall, the findings demonstrated that while teachers were passionate and knowledgeable about technology, they were limited in their knowledge of how to transform and alter instructional practices to more effectively integrate technology and 21st century skills. From the data, recommendations on how to increase the quality of the already present technology integration can be made,
Delimitations and Limitations of the Study

This case study was limited to three elementary schools in one district in Massachusetts. The data collected from interviews, observations, and TSAT analysis revealed the opinions of only six elementary teachers and their classrooms within the district. Therefore, the results cannot be generalized to all teachers within the district or to other elementary schools. Many factors influence technology integration, including, but not limited to, the perceptions and motivation of staff, the support of administrators within a district, the quantity and type of technology available, and the amount of trainings offered to staff. The six teacher participants were also all identified for the study because of their use of technology and passion for technology in the classroom. Therefore, their technology use and perceptions regarding technology cannot be generalized to all teachers.

Furthermore, the researcher is a teacher within the school district and a colleague of teacher participants. The researcher also utilizes technology in the classroom and, therefore, is a proponent of integrating technology into elementary classrooms.

Recommendations

This study was a descriptive, embedded, single case study of the technology use in a school district in Central Massachusetts. The study examined how and why teachers in three elementary schools integrated technology into their daily teaching and how these teachers addressed 21st century skills while teaching with technology. This research study utilized interviews with all six teacher participants, results of teachers’ TSATs, and
multiple observations of lessons incorporating technology. Multiple data sources depicted a clear picture of how these teachers utilized, and did not utilize, technology in their daily lessons and how did and did not address 21st century skills while teaching with technology. The following are recommendations to improve the effectiveness of technology integration and incorporation of 21st century skills in a school district in Central Massachusetts.

1. The district should consider providing more training on the use of technology in classrooms. Teachers commented they had been given very limited training on technology, usually a one-day workshop. In order to influence and change teachers’ attitudes and beliefs about technology and teaching strategies to utilize with technology, professional development needs to be developed in a way that promotes actual change in the classroom. For teachers to recognize the benefits of professional development they need to see improvements in student learning before their attitudes and beliefs will change (Guskey, 2002). Furthermore, teachers need to realize that the goals associated with the professional development will not interfere with other higher-level goals (Scott & Mouza, 2007). To do this, the district could supplement the basic training on how to utilize technology with more advanced professional development about how to effectively incorporate technology into lesson content. The professional development could provide teachers with information about how to balance technology, content, pedagogy, and context in lessons. Through this training, teachers could learn how to more effectively plan lessons with technology in mind, instead of incorporating it as an add-on after all lesson planning is finished.
To effectively change teachers’ practices, the professional development would need to be ongoing, providing teachers with support throughout implementation, providing follow-up, support, and pressure (Guskey, 2002). Additionally, to break through teachers’ isolation barriers and increase collaboration, professional development communities (PDCs) could be formed to further support the implementation. Professional development communities can help enable change and can break down barriers that might prevent change (Hadar & Brody, 2010).

There is a distinct knowledge gap between the online learning theory and its idea of how technology should be incorporated into the classroom and the practical application of how teachers utilize technology in the classroom. Professional development could be aimed at bridging the gap between the knowledge of the theoretical frameworks of online learning theory and classroom practice.

2. Administrators should consider providing more time for teachers to collaborate with each other about their technology use in the classroom. From the study, it was apparent that learning with and through colleagues is an important and essential aspect of increasing teacher learning about technology use in the classroom. Therefore, after the professional development designed to provide teachers with more knowledge and skills on how to more effectively incorporate technology into the classroom, collaborative time could be organized so that teachers can further their learning with each other and share how they are implementing new concepts. Moreover, this collaborative time would enable teachers newer to technology to learn from teachers with more technology expertise.
3. The district should consider providing teachers with more information on 21st century skills. It is evident that teachers have basic knowledge of what 21st century skills are, the importance of 21st century skills to elementary students, and how to incorporate these skills with content into daily lessons. A two-part professional development could occur where teachers could first learn what 21st century skills are composed of and the relevance of these skills to their students. The second part could be a practical application of how to create and alter lessons to skillfully incorporate these skills. Teachers would benefit from learning and practicing how to teach with some of the instructional strategies proven to facilitate teaching and learning with technology and 21st century skills. This professional development should also include follow-up in order to ensure implementation and a change in beliefs and attitudes of teachers (Guskey, 2002).

4. It is recommended that the elementary schools convene a team to look at how 21st century skills can be effectively incorporated into classrooms and what skills are most essential for teachers to highlight. This team could meet with middle school and high school teachers to determine the skills students will need to possess to be successful in their later educational careers.

**Recommendations for Further Study**

1. Since this study focused on six teacher participants from the same school district, it is recommended that future studies investigate technology use in elementary classrooms in other districts. It is recommended that this study focus on teachers in districts that have had substantial professional development in teaching with technology to explore whether teachers have transformed their teaching methods
while teaching with technology. The study should evaluate and describe the transformed teaching methods, along with the types of professional development that fostered this transformation.

2. From the results of this study, it appeared that students had different levels of engagement with technology depending on the type of technology utilized in the classroom and the degree of participation of students. It is recommended that a future study focus on student engagement in lessons with technology, isolating variables that could potentially affect students’ engagement, such as the type of technology utilized, the methods with which it is employed, and the degree of participation of students.

3. From this study, collaboration and communication between peers appeared to be facilitated by certain types of technology and hindered by other types of technology. It is recommended that future studies investigate collaboration among peers and how technology affects student collaboration in the classroom to isolate the specific factors of technology use that might hinder or facilitate collaboration during lessons with technology.

4. In this study, most teachers taught with technology using teacher centered technology the majority of the time. It is recommended that future studies investigate teacher centered technology use in comparison to student centered technology use to ascertain which method is more effective for student learning.

5. Another recommendation is for a future study to expand upon student participation in lessons with technology. Students appeared to be more motivated and engaged when they were participating with technology or through other
participatory means. A future study should further explore different methods of participation in lessons with technology and the effect that increased participation has on student learning and engagement.


Journal of Special Education Technology, 9(1), 5-21.


Appendices

Appendix A: List of Technology terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Technology Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>IWB</td>
<td>Interactive Whiteboard</td>
</tr>
<tr>
<td>MUVE</td>
<td>Multi-User Virtual Experience</td>
</tr>
<tr>
<td>PBL</td>
<td>Problem-based Learning</td>
</tr>
<tr>
<td>TSAT</td>
<td>Technology Self-Assessment Tool</td>
</tr>
<tr>
<td>SMALLab</td>
<td>Situated Multimedia Arts Learning Lab</td>
</tr>
<tr>
<td>MKO</td>
<td>More Knowledgeable Other</td>
</tr>
<tr>
<td>ZPD</td>
<td>Zone of Proximal Development</td>
</tr>
</tbody>
</table>
Appendix B – Teacher Recruitment E-mail

Principal Introduction:
Dear Staff,

Please see the attached document regarding a research opportunity. Your decision to participate will have no effect on your standing in the [ ] Schools.

Recruitment E-mail:

Dear Colleagues,

My name is Rebekah Cain, and I am a first grade teacher at [ ]. I am also a student in College of Professional Studies at Northeastern University. I would like you to consider participating in my research study. The purpose of the study is to investigate the best practices of technology integration in elementary classrooms. I am looking for teachers who currently use technology in their classroom. To be a participant, you and your classroom would be observed during a lesson with technology 4-6 times, and you would participate in 2-4 interviews lasting 30 minutes each. All of the interviews would occur in your classroom before or after school. The decision to participate in this study is completely voluntary. You do not have to participate, and, even if you do decide to participate, you may stop at any time.

Your part in this study will be handled in a confidential manner. Any reports or publications based on this research will use pseudonyms and will not identify you, your school, your school district, or any individual as being affiliated with this project.

If you are interested or have any questions about this study, please contact me 802-233-7624 or cainra@gmail.com.

Thank you for your consideration,

Rebekah Cain
Appendix C – Follow-up Teacher Recruitment E-mail

Principal Introduction:

Dear Staff,

Please see the attached reminder regarding a research opportunity. Your decision to participate will have no effect on your standing in the [ ] Schools.

Recruitment E-mail:

Dear Colleagues,

For those of you who have contacted me about participating in my study, thank you very much. If you have not, please consider becoming a participant in my study. I would greatly appreciate your input.

My name is Rebekah Cain, and I am a first grade teacher at [ ]. I am also a student in College of Professional Studies at Northeastern University. I would like you to consider participating in my research study. The purpose of the study is to investigate the best practices of technology integration in elementary classrooms. I am looking for teachers who currently use technology in their classroom. To be a participant, you and your classroom would be observed during a lesson with technology 4-6 times, and you would participate in 2-4 interviews lasting 30 minutes each. All of the interviews would occur in your classroom before or after school. The decision to participate in this study is completely voluntary. You do not have to participate, and, even if you do decide to participate, you may stop at any time.

Your part in this study will be handled in a confidential manner. Any reports or publications based on this research will use pseudonyms and will not identify you, your school, your school district, or any individual as being affiliated with this project.

If you are interested or have any questions about this study, please contact me 802-233-7624 or cainra@gmail.com.

Thank you for your consideration,

Rebekah Cain
Appendix D – Teacher Signed Consent Form

Teacher Signed Consent Form

Northeastern University, College of Professional Studies

Investigator’s Name:
- Kelly Conn, Principal Investigator
- Rebekah Cain, Doctor of Education Student in the College of Professional Studies at Northeastern University

Title of Project: A Case Study of Best Practices of Technology Integration in Elementary Classrooms

You are being invited to take part in a research study. This form will tell you about the study, but the researcher will explain it to you first. You may ask this person any questions that you have. When you are ready to make a decision, you may tell the researcher if you want to participate or not. You do not have to participate if you do not want to. If you decide to participate, the researcher will ask you to sign this statement and will give you a copy to keep.

Why are you being asked to take part in this research study? You are being asked to participate in this research study because you are a teacher who utilizes technology in an elementary classroom.

Why is this research being done? The purpose of this research is to gather information about the best ways to integrate technology into an elementary classroom.

What will I be asked to do? If you decide to take part in this study, you will be asked to fill out the Technology Self-Assessment Tool (TSAT). After completion of the TSAT, the researcher will observe you and your classroom during 4-6 lessons utilizing technology in your classroom. Following each lesson, a brief feedback session will take place to solicit student feedback.

You will also be asked to have 2-4 one-on-one audio taped interviews with the researcher. The interviews will be audio taped for transcription purposes only.

Where will this take place and how much time will it take? The TSAT will be self-administered and should take 15-20 minutes. Observations will take place in your classroom for 40 minutes each for a total of 4-6 lessons. Student feedback sessions will occur after each lesson and will last approximately 5 minutes. One-on-one interviews will take place in your classroom either before or after school and will last for approximately 30 minutes for a total of 2-4 interviews.
Will there be any risk or discomfort to me? There is no foreseeable risk or discomfort anticipated.

Will I benefit to being in this research? There will be no direct benefit to you for taking part in the study. However, the information learned from this study may help elementary teachers integrate technology into classrooms in more effective ways.

Who will see the information about me? As a participant of this research, your part will be confidential. Only the researcher of this study will see the information about you. You will have a pseudonym to protect your identity. No reports or publications will use information that can identify you, your school district, or any individual in any way. The data collected for this study will be kept by the researcher, including audiotapes, and will not be shared with others. Audiotapes will be destroyed following transcription and analysis.

In rare instances, authorized people may request to see research information about you and other people in this study. This is done only to be sure that the research is done properly. The researcher would only permit people who are authorized by organizations such as Northeastern University to see this information. No identifying information will ever be shared with people at the public schools in [ ].

Can I stop my participation in this study? Your participation in this research is completely voluntary. You do not have to participate if you do not want to. Even if you begin the study, you may quit at any time. You may also refuse to answer any questions. If you do not participate or if you decide to quit, you will not lose any rights, benefits, or services that you would otherwise have.

Who can I contact if I have questions or problems?
Rebekah Cain Dr. Kelly Conn
Doctor of Education Student Assistant Academic Specialist
College of Professional Studies College of Professional Studies
675 Chestnut Hill Ave Northeastern University
Brookline, MA 02445 360 Huntington Ave 42BV
802-233-7624 857-205-9585
Email: cainra@gmail.com Email: kconn@neu.edu

Who can I contact about my rights as a participant? If you have any questions about your rights as a participant, you may contact Nan C. Regina, Director, Human Subject Research Protection, 960 Renaissance Park, Northeastern University Boston, MA 02115 tel. 617-373-4588, email: irb@neu.edu. You may call anonymously if you wish.

Will I be paid for my participation? There is no compensation for participation in this study.

Will it cost me anything to participate? There is no cost to participate.
I have read, understood, and had the opportunity to ask questions regarding this consent form. I fully understand the nature and character of my involvement in this research as a participant and the potential risks. I agree to participate in this study on a voluntary basis.

____________________________________________
Research Participant (signature)                        Date

____________________________________________
Research Participant (printed)

____________________________________________
Researcher who explained the study to the participant above and obtained consent (signature)                        Date

____________________________________________
Researcher (printed)
Appendix E – Teacher Interview Protocol and Questions

Teacher Interview

Interview Protocol:
• All interviews will be audio taped and later transcribed to provide the most accuracy.
• All interviews will be conducted and transcribed by Rebekah Cain, Northeastern student in College of Professional Studies.
• All interviews will occur in the teacher participant’s classroom, either before or after school.
• Interviews will last approximately 30 minutes each and will occur between 2-4 times. There will be one primary interview for each teacher participant and 1-3 follow up interviews for each participant.

Primary Interview Questions:

Introductory Question:
• Describe your experience with technology in the classroom?

Main Questions:
• Why do you use technology in the classroom? What benefits do you believe technology offers students?
• What types of technology do you use in the classroom?
• How do you use technology to teach lessons?
• What instructional methods do you utilize when teaching with technology?
  ○ If needed to rephrase – what type of teaching methods do you use when teaching with technology?
• How do students react when you use technology in the classroom?
• How did you learn how to use technology in the classroom? How do you learn about new types of technology?
• What content areas do you use when you use technology? Do you use technology differently with different content areas?
• Are you familiar with 21st century skills? (problem solving, critical thinking, collaborative, communicative, creativity, and innovation) Do you address any of these skills when utilizing technology in the classroom?
  ○ If teacher does not know what 21st century skills are, the following questions will be utilized?
    ▪ Do you use technology to strengthen students’ problem solving and critical thinking skills? How?
    ▪ Do you use technology to strengthen students’ collaborative and communicative skills? How?
    ▪ Do you use technology to strengthen students’ creativity and innovation? How?
• How do you decide to utilize technology in a lesson? The content area? The subject matter? The activity? The difficulty for students?
• When using technology in a lesson, which aspect of the lesson do you plan first?
  ▪ The content of the lesson?
  ▪ The way they are going to use technology in the lesson?
  ▪ The type of technology?

Concluding Question:
• Is there anything else you would like me to know?

Follow up Interview Questions (After primary Interview):

Introductory Question:
• Can you describe how you used technology in this lesson?

Main Questions:
• How did you decide to use technology to teach this lesson?
• When you want to use technology with a lesson, do you first plan the content of the lesson or the technology used in the lesson?
• What did you think were the strengths of the technology use in this lesson?
• How do you think the technology used in this lesson could be improved?
• What technological skills did students need to know in order to participate in this lesson?
• What technological skills did you need to teach students in order for them to participate in this lesson?

Concluding Question:
• Is there anything else you want me to know?
Appendix F – Massachusetts Technology Self-Assessment Tool (TSAT)

Welcome to the Massachusetts Technology Self-Assessment Tool

The technology instrument has been designed for:

1. **Teachers**: to determine their own levels of technology proficiency and to identify personal technology professional development needs.

2. **Schools/Districts**: to assess their professional development needs and to plan professional development activities that will help all teachers become proficient in technology.

3. **The State**: to gather and report data on technology competencies and technology professional development.

Using the Technology Self-Assessment Tool

There are two ways you can use the TSAT. You can read through the entire documents, checking off skills that you have attained, or you can complete one level at a time, stopping when you reach a level you have not yet mastered. Although some levels do not require that you complete all of the skills to attain mastery, you can go back at any time to check off new skills when you learn them.

**Mastery Levels**

The TSAT has four mastery levels, as shown in the table below. The table show the percentage of skills that you should complete in order to move to the next level. Although some levels do not require that you complete all of the skills, you can go back at any time to check off new skills you have learned.

<table>
<thead>
<tr>
<th>Technology Operations &amp; Concepts</th>
<th>Ethics &amp; Safety</th>
<th>Teaching &amp; Learning with Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Technology</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Developing Technology</td>
<td>80%</td>
<td>100%</td>
</tr>
<tr>
<td>Proficient</td>
<td>80%</td>
<td>100%</td>
</tr>
</tbody>
</table>
If this is the first time you are taking this assessment, you should begin at Early Technology. The assessment presents a list of skills with check boxes. Check a skill if you are able to do all of the examples given. You can take the assessment as many times as you wish. When you have completed a skill level, proceed to the next higher level. For example, once you master the skills in Early Technology, you should begin working on the Developing Technology level.

<table>
<thead>
<tr>
<th>I Know How To</th>
<th>Standard 1 – Technology Operations and Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1.1</td>
<td>Identify components of a computer system and its operating system (e.g., drives, memory, window). Explain the functions of the components, and use appropriate terminology in speaking about them.</td>
</tr>
<tr>
<td>A1.2</td>
<td>Connect the cables and cords correctly so that a computer is functional. Reduce the risk of hardware failure through proper care of the components.</td>
</tr>
<tr>
<td>A1.3</td>
<td>Demonstrate basic skills for using hardware and applications (e.g., start up and shut down computer system and peripherals, open and close a file, start an application and create a document).</td>
</tr>
<tr>
<td>A1.4</td>
<td>Follow the proper district/school procedures in the event of technical difficulties.</td>
</tr>
<tr>
<td>A1.5</td>
<td>Navigate using scroll bars, arrow keys, special keys, trackpads/touchpads, and mice.</td>
</tr>
<tr>
<td>A1.6</td>
<td>Save/backup and retrieve a file to/from local hard drive, portable disk/device, and/or online storage location.</td>
</tr>
<tr>
<td>A1.7</td>
<td>Select a printer and print a document with appropriate resolution and orientation (portrait or landscape).</td>
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<tr>
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<tr>
<td><strong>A1.8</strong></td>
<td>Use basic editing and formatting features of a word processing program (e.g., centering, spacing, fonts, enter text, edit, copy and paste, and insert graphics).</td>
</tr>
<tr>
<td><strong>A1.9</strong></td>
<td>Explain the concept of a database, and provide examples from everyday life (e.g., library catalogs, school records, telephone directories).</td>
</tr>
<tr>
<td><strong>A1.10</strong></td>
<td>Use correct terminology in speaking about Internet communications (e.g., browser, search engine, website, URL, domain, links).</td>
</tr>
<tr>
<td><strong>A1.11</strong></td>
<td>Explain terms related to the use of networks (e.g., username, password, network, server, domain).</td>
</tr>
<tr>
<td><strong>A1.12</strong></td>
<td>Select a strong (secure) password and keep it safe.</td>
</tr>
<tr>
<td><strong>A1.13</strong></td>
<td>Access the Web and identify and use navigation features of an Internet (e.g., “home,” “back,” “forward,” hyperlinks, and multiple tabs).</td>
</tr>
<tr>
<td><strong>A1.14</strong></td>
<td>Add a website to <em>Favorites</em> or <em>Bookmark</em> it for future reference.</td>
</tr>
<tr>
<td><strong>A1.15</strong></td>
<td>Create and send a message using email. Retrieve and read email. Reply to sender and forward an email and attach a file. Save, print and delete an email. Differentiate between “reply” and “reply to all.”</td>
</tr>
<tr>
<td><strong>A1.16</strong></td>
<td>Send an email attachment. Receive an attachment, open it, and save it to an appropriate location.</td>
</tr>
</tbody>
</table>

**I Know How To**

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</thead>
<tbody>
<tr>
<td><strong>A2.1</strong></td>
<td>Explain and comply with the Acceptable Use Policy in your district and describe the consequences of failing to comply.</td>
<td></td>
</tr>
<tr>
<td><strong>A2.2</strong></td>
<td>Explain and apply classroom/lab rules for responsible and equitable use of technology.</td>
<td></td>
</tr>
</tbody>
</table>

**Standard 2 – Ethics and Safety**
| A2.3 | Explain potential problems viruses and other malware create and practical methods of prevention (including exercising caution in opening email attachments and installing software). |
| A2.4 | Identify key intellectual property issues that apply to technology use in education, the workplace and society (e.g., fair use, copyright, software licensing, plagiarism). |
| A2.5 | Follow appropriate licensing for all software and content used. |
| A2.6 | Discuss the basic concept of assistive technologies and Universal Design for Learning (UDL). |
| A2.7 | Evaluate the proper physical setting for technology use (ergonomics). |
| A2.8 | Explain how media and technology can be used to distort or exaggerate information. |

<table>
<thead>
<tr>
<th>I Know How To</th>
<th>Standard 3 – Teaching &amp; Learning with Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>A3.1</td>
<td>Discuss current best practices on teaching and learning with technology in order to plan rich learning environments and experiences.</td>
</tr>
<tr>
<td>A3.2</td>
<td>Use technology to gather curriculum-specific information from online and/or local digital sources.</td>
</tr>
<tr>
<td>A3.3</td>
<td>Integrate technology into the curriculum of one’s subject and/or grade level with assistance of a coach, mentor or other staff member.</td>
</tr>
<tr>
<td>A3.4</td>
<td>Use digital and online tools to communicate with teachers, parents, and other stakeholders and to create/distribute classroom materials.</td>
</tr>
<tr>
<td>A3.5</td>
<td>Identify your personal technology professional development needs.</td>
</tr>
</tbody>
</table>

<p>| B. Developing Technology |</p>
<table>
<thead>
<tr>
<th>I Know How To</th>
<th>Standard 1 – Technology Operations and Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1.1</td>
<td>Connect a computer to peripheral equipment (e.g., scanner, printer, projector).</td>
</tr>
<tr>
<td>B1.2</td>
<td>Identify and use a variety of storage media (e.g., CD/DVD, flash drives, network servers, online storage spaces). Explain why a particular medium is or is not suited for a particular storage task.</td>
</tr>
<tr>
<td>B1.3</td>
<td>Resolve basic technical difficulties (e.g., reboot computer, clear paper jam, replace ink cartridge replacement).</td>
</tr>
<tr>
<td>B1.4</td>
<td>Use built-in help and other available support resources to learn about hardware and software features and to troubleshoot problems.</td>
</tr>
<tr>
<td>B1.5</td>
<td>Use proper terminology to communicate commonly occurring technology problems (e.g., frozen screen, disk error, printing problems).</td>
</tr>
<tr>
<td>B1.6</td>
<td>Use editing and formatting features (margins, spelling, and tabs) in a word processing application. Insert images (e.g., downloaded from the Web or copied from a removable device) into documents.</td>
</tr>
<tr>
<td>B1.7</td>
<td>Create a report or newsletter using word-processing or desktop publishing software.</td>
</tr>
<tr>
<td>B1.8</td>
<td>Describe the structure and function of spreadsheet (e.g., cells, rows, columns, and formulas).</td>
</tr>
<tr>
<td>B1.9</td>
<td>Create an original spreadsheet, entering simple formulas (various number formats, equations, percentages). Reposition columns and rows; apply formatting features.</td>
</tr>
<tr>
<td>B1.10</td>
<td>Interpret spreadsheet information, and produce simple charts from data.</td>
</tr>
<tr>
<td>B1.11</td>
<td>Perform basic searches (including multiple key words) on digital and online databases (e.g., library card catalog, encyclopedia). Use available tools to refine and limit the results of a search.</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>B1.12</td>
<td>Create and manipulate graphics using a drawing or painting program (e.g., adjust scale, size, shape, resolution).</td>
</tr>
<tr>
<td>B1.13</td>
<td>Create a simple multimedia presentation and explain the terminology (e.g., slide, transition, build.).</td>
</tr>
<tr>
<td>B1.14</td>
<td>Organize Bookmarks or Favorites into folders for future reference.</td>
</tr>
<tr>
<td>B1.15</td>
<td>Identify and use basic search strategies on the Internet.</td>
</tr>
<tr>
<td>B1.16</td>
<td>Create an address book in an e-mail program.</td>
</tr>
</tbody>
</table>

**Standard 2 – Ethics and Safety**

<table>
<thead>
<tr>
<th>I Know How To</th>
<th>Ensure equitable access to technology resources for all students in the class.</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2.1</td>
<td>Use basic assistive technology features of operating systems and applications. For example, change text size in a word processor, use text-to-speech features, change mouse controls, use on-screen calculators.</td>
</tr>
<tr>
<td>B2.2</td>
<td>Cite electronic sources correctly in accordance with academic standards (e.g., APA); explain and model this in the classroom.</td>
</tr>
<tr>
<td>B2.3</td>
<td>Explain and demonstrate ethical and legal behavior (including fair use guidelines) in copying/downloading files, applications, and media.</td>
</tr>
<tr>
<td>B2.5</td>
<td>Evaluate a website’s validity as a source of information (e.g., find site sponsor, author, date the site was last updated, etc.).</td>
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| I Know How To | C. Proficient
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<tr>
<td><strong>C1.1</strong> Recognize and work with a variety of different multimedia and document formats (e.g., jpg, html, mp3, pdf, doc, odt).</td>
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<tr>
<td><strong>C1.2</strong> Determine the size and format of files, to identify the storage space remaining on drives, and to identify the version of an application in use.</td>
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<td><strong>C1.3</strong> Install new software from a variety of sources (e.g., CD, DVD and the Internet) per district policies.</td>
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<tr>
<td><strong>C1.4</strong> Resolve commonly occurring technology problems (e.g., frozen screen, disk error, printing problems).</td>
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<tr>
<td><strong>C1.5</strong> Demonstrate intermediate word processing skills (e.g., indents, headers and footers, end notes, bullets and numbering, tables, track changes, insert comments).</td>
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<tr>
<td><strong>C1.6</strong> Use built-in calculating functions (e.g., sum, average) in a spreadsheet application.</td>
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<tr>
<td><strong>C1.7</strong> Customize formatting of charts or graphs created in spreadsheet. Define and use built-in data functions of a spreadsheet such as sort, filter, find.</td>
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<tr>
<td><strong>C1.8</strong> Differentiate between formulas with absolute cell references and relative cell references in a spreadsheet.</td>
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<tr>
<td><strong>C1.9</strong> Use multiple sheets within a spreadsheet and link cells together across sheets.</td>
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<tr>
<td><strong>C1.10</strong> Define terms (field, table, record, query, etc.) and functions related to databases.</td>
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<tr>
<td><strong>C1.11</strong> Perform simple operations in a database (e.g., browse, sort, search, delete, add data, define field formats).</td>
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</table>
| **C1.12** Create a multimedia presentation that includes a design template, tables,
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<tr>
<th>I Know How To</th>
<th>Standard 2 – Ethics and Safety</th>
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<tbody>
<tr>
<td>C2.1</td>
<td>Use assistive technology software (e.g., text-to-speech, word prediction, voice recognition, word-symbol, communication software).</td>
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<tr>
<td>C2.2</td>
<td>Address situations where inappropriate technology use occurs, and contact proper district personnel to take action.</td>
</tr>
<tr>
<td>C2.3</td>
<td>Demonstrate and teach students the principals of ergonomics (e.g., avoiding repetitive stress injuries maintaining proper posture) as well as how to use equipment safely.</td>
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<tr>
<th>I Know How To</th>
<th>Standard 3 – Teaching &amp; Learning with Technology</th>
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<tbody>
<tr>
<td>C3.1</td>
<td>Plan for the management of technology resources within the context of learning activities (e.g., schedule use of computer lab, wireless laptops, whiteboard).</td>
</tr>
<tr>
<td>C3.2</td>
<td>Evaluate technology resources, including online resources for accuracy and suitability for your curriculum area and the students you teach.</td>
</tr>
<tr>
<td>C3.3</td>
<td>Identify and discuss the technology proficiencies needed in the workplace, as well as strategies for acquiring these</td>
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<tr>
<td><strong>C3.4</strong></td>
<td>Use appropriate technology tools to enhance your curriculum (e.g., digital projectors, wireless laptops, handhelds, environmental probes).</td>
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<tr>
<td><strong>C3.5</strong></td>
<td>Facilitate technology-enhanced lessons that address content standards and student technology literacy standards, while addressing a variety of learning styles.</td>
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<tr>
<td><strong>C3.6</strong></td>
<td>Use technology resources to collect and analyze data, interpret results, and communicate findings to improve instructional practice and maximize student learning.</td>
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<tr>
<td><strong>C3.7</strong></td>
<td>Identify and evaluate developing technologies as they relate to your subject area, grade level and student population.</td>
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<tr>
<td><strong>C3.8</strong></td>
<td>Assess student learning using a variety of district, school or individual technology tools and strategies (e.g., the state Data Warehouse, progress spreadsheets, or commercial gradebook applications).</td>
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<tr>
<td><strong>C3.9</strong></td>
<td>Provide assistance to colleagues in using multimedia presentations, WebQuests, and other technology-rich lessons in the classroom.</td>
</tr>
<tr>
<td><strong>C3.10</strong></td>
<td>Manipulate data using charting tools and graphic organizers (e.g., concept mapping, and outlining software) to connect ideas and organize information.</td>
</tr>
<tr>
<td><strong>C3.11</strong></td>
<td>Use electronic communication tools (e.g., message boards, email, virtual classrooms) to enhance teaching and learning.</td>
</tr>
<tr>
<td><strong>C3.12</strong></td>
<td>Use the Internet to network with other teachers and learn about effective use of technology in teaching your subject(s).</td>
</tr>
<tr>
<td><strong>C3.13</strong></td>
<td>Explain and correctly use terms related to online learning (e.g., upload, download, forum, journal, post, thread, intranet, drop box, account).</td>
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<tr>
<td>C3.14</td>
<td>Facilitate student use of online tools (e.g., blogs, wikis, message boards) to gather and share information collaboratively.</td>
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**D. Advanced**

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<tr>
<th>I Know How To</th>
<th>Standard 1 – Technology Operations and Concepts</th>
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| D1.1 | Install and troubleshoot new hardware. |
| D1.2 | Understand the differences between common file types, and identify the appropriate use of each. Identify methods of converting one file to another type. Use different graphic file formats where appropriate (e.g., jpg to png, wav to mp3). |
| D1.3 | Import/export and link data between spreadsheet, databases and other applications, including presentation applications. |
| D1.4 | Explain and demonstrate effective strategies for backing up and restoring personal computer data. |
| D1.5 | Design, create, modify and manipulate an original database. |
| D1.6 | Be able to do queries and create reports from a database. |
| D1.7 | Explain and properly use terms related to networks and Internet infrastructure (e.g., LAN, WAN, DSL, T1, router, firewall, IP address, DHCP, DNS, POP, IMAP). |

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<th>I Know How To</th>
<th>Standard 2 – Ethics and Safety</th>
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<p>| D2.1 | Manage assistive technology equipment and install peripherals for diverse learners (e.g., alternative keyboards, |</p>
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<th>I Know How To</th>
<th>Standard 3 – Teaching and Learning with Technology</th>
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<td>D2.2</td>
<td>Explain basic practices that contribute to a website's accessibility to people with disabilities (e.g., use of alternative text to describe graphics, providing captions for audio, maintaining consistency in the interface).</td>
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<tr>
<td>D2.3</td>
<td>Discuss how copyright law and fair use is affected by, and affects, the use of the Internet.</td>
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<tr>
<td>D3.1</td>
<td>Routinely and rigorously identify, evaluate, and apply emerging technologies as they relate to teaching and learning.</td>
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<tr>
<td>D3.2</td>
<td>Use specialized technology tools for problem solving, decision-making, and creativity (e.g., simulation software, geographic information systems, dynamic geometric software, art and music composition software).</td>
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<tr>
<td>D3.3</td>
<td>Develop tools and online content (e.g., web pages, blogs, wikis, mailing lists) for instruction and communication among students and faculty.</td>
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<tr>
<td>D3.4</td>
<td>Use technology (e.g., applets that require the use of logic to solve problems) to challenge students to develop higher order thinking skills and creativity.</td>
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<tr>
<td>D3.5</td>
<td>Plan and implement collaborative projects with other classrooms or schools using interactive tools (e.g., email, discussion forums, groupware, interactive websites, VoIP, videoconferencing).</td>
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<tr>
<td>D3.6</td>
<td>Present ideas using the most appropriate communications technologies (e.g., multimedia presentations, web pages, desktop-published documents).</td>
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<tr>
<td>D3.7</td>
<td>Distinguish between effective and ineffective design and presentation in electronic format (e.g., websites, multimedia, charts).</td>
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<tr>
<td>D3.8</td>
<td>Explain and demonstrate the use of metadata (e.g., tagging, EXIF) to help students and teachers organize information on their computers and/or the Internet.</td>
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<tr>
<td>D3.9</td>
<td>Design and deliver effective staff development in technology and its integration into the curriculum.</td>
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Appendix G – Signed Letter of Permission

November 7, 2011

Re: Rebekah Cain

To Whom It May Concern:

This letter is to certify that I give Rebekah Cain, first grade teacher and Northeastern Doctor of Education student, permission to conduct her doctoral study in the [redacted] I give permission for her to conduct her study as outlined in her doctoral thesis proposal entitled, “A Case Study of Best Practices of Technology Integration in Elementary Classrooms,” utilizing elementary teachers and elementary students who provide informed consent from the [redacted] as participants.

If you have any questions, please contact me at [redacted]

Sincerely,

Superintendent of Schools
Appendix H – IRB Approval

NOTIFICATION OF IRB ACTION

Date: November 18, 2011      IRB #: 11-10-08
Principal Investigator(s):    Kelly Conn
                              Rebekah Cain
Department:                  Doctor of Education Program
                              College of Professional Studies
Address:                     42 Belvidere
                              Northeastern University
Title of Project:            A Case Study of Best Practices of Technology
                              Integration in Elementary Classrooms
Participating Sites:         - permission letter received
DHHS Review Category:        Expedited #6, #7 – pertains to teacher interviews
                              Exempt #1, #2 – pertains to classroom observation and
                              student feedback sessions
Informed Consents:           One (1) signed consent form for teachers
Monitoring Interval:         12 months

APPROVAL EXPIRATION DATE: NOVEMBER 17, 2012

Investigator’s Responsibilities:
1. The informed consent form bearing the IRB approval stamp must be used when
   recruiting participants into the study.
2. The investigator must notify IRB immediately of unexpected adverse reactions, or new
   information that may alter our perception of the benefit-risk ratio.
3. Study procedures and files are subject to audit any time.
4. Any modifications of the protocol or the informed consent as the study progresses must
   be reviewed and approved by this committee prior to being instituted.
5. Continuing Review Approval for the proposal should be requested at least one month
   prior to the expiration date above.
6. This approval applies to the protection of human subjects only. It does not apply to any
   other university approvals that may be necessary.

C. Randall Colvin, Ph.D., Chair
Northeastern University Institutional Review Board

Human Subject Research Protection
Northeastern University FWA #4630