VITA

Kathryn D. Goad

EDUCATION

2012	Indiana State University, Terre Haute, Indiana Ph.D. in Educational Administration
2009	Indiana State University, Terre Haute, Indiana Ed.S. in Educational Administration
2006	Indiana State University, Terre Haute, Indiana M.S. in Educational Administration
1975	Indiana State University, Terre Haute, Indiana B.S. in Vocational Home Economics Education

PROFESSIONAL EXPERIENCE

2012	Tri-County School High School, Wolcott, Indiana Middle Senior High School Principal
2001 – 2006	West Central High School, Francesville, Indiana Middle Senior High School FACS Teacher
1993 – 2001	Oaklawn Elementary School, Monticello, Indiana Early Childhood Education Teacher

THE PERCEPTION OF TEACHERS TOWARD THE USE OF MOBILE TECHNOLOGY AS A TOOL TO ENGAGE STUDENTS IN LEARNING

A Dissertation

Presented to

The College of Graduate and Professional Studies

Department of Educational Leadership

Indiana State University

Terre Haute, Indiana

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

---

by

Kathryn Dawn Goad

May 2012

Keywords: Mobile devices, cell phones, student engagement, mobile learning, applications (apps)

COMMITTEE MEMBERS

Committee Chair: Steven Gruenert, Ph.D.

Associate Professor of Educational Leadership

Indiana State University

Committee Member: William Barratt, Ph.D.

Professor of Educational Leadership

Indiana State University

Committee Member: Beth Whitaker, Ph.D.

Professor of Elementary, Early, and Special Education

Indiana State University

ABSTRACT

The purpose of this study was to gauge the perception of teachers on the use of mobile technology, specifically cell phones, as an instructional tool to engage students in learning. Cell phones are the most ubiquitous piece of technology in the world. Their multiple functions can put the most up-to-date information at the fingertips of the user. However, schools have been slow to embrace these devices out of fear and ignorance on how to use their capabilities. Research is limited on this subject; most coming from cell phone manufacturers and related service providers. The opportunity to explore this technology tool as an instructional aid and provide educators with data to support the use of the cell phone in the classroom was both timely and evoking.

The study queried 500 public school teachers in the Midwest on their proficiency with technology, their perception of the importance in using technology, their opinions on using technology in the classroom, and their specific integration of cell phones in their lessons. Of the respondents, 28.5% had experience using cell phones in the classroom. This was in comparison to national statistics of 75% of students having daily access to a phone.

A Mann-Whitney *U* test found no significant difference between STEM teachers and teachers of other disciplines in their perceptions of the importance of using technology in the classroom. However, when conducting a *t*-test with the same two groups of teachers there was a significant difference in their ability to design and access lessons using technology. STEM teachers rated themselves at a higher skill level than did the teachers of other disciplines.

A Pearson correlation examined the relationship between teacher comfort level with technology and the teacher's ability to design and access lessons using technology. A significant, positive relationship was found in that as the level of technology use increased the teacher ability to design and access lessons increased. With an *r* value of .742 this correlation was considered strong.

The question posed was "Are levels of student engagement different based on the frequency of integration of technology?*"* Through the use of a one-way ANOVA there was no significant difference in student engagement based on the frequency of its use. A multiple regression was used to determine which of the nine proficiency indicators serve as predictors for student engagement. Two proficiencies, "using software productivity tools" and "locating learning opportunities needed to advance my technology skills" were both found to be significant negative *predictors,* and "proficiency of troubleshooting problems that occur when using technology" was a significant positive predictor of student engagement.

Student engagement was discussed through the summary of experience responses of 44 teachers surveyed. These written responses provided depth to the study when investigating teacher perceptions of student engagement when cell phones are used as an instructional tool.

ACKNOWLEDGMENTS

I would like to thank my family for the patience and encouragement they have shown me through this process. While I didn't appreciate it at the time, the work ethic that I was raised with helped me to persevere through every word and challenge of this dissertation.

I would like to thank my school family at Tri-County Middle Senior High School. The school board and superintendent were generous in the time they allowed me to pursue my dream. The teachers and staff were always encouraging and served as terrific cheerleaders through this marathon event. I'm sure they are as happy as I to see the finish line. Special thanks go to Darla Harrington, Judy Kochert, Diane Smith, and Becky Streitmatter for their diligent work in developing my database of teacher email addresses.

My Terre Haute connection made the laborious trips back and forth to ISU accommodating, eventful, and fun. I could always count on that hospitality.

Finally, I am grateful for the support of my committee members. Dr. Barratt's enthusiasm for my topic helped me catch fire early on. Dr. Whitaker's acknowledgment of the relevance of the topic to teachers assured me that I had chosen not only a timely but exciting area to study. Dr. Gruenert has been instrumental in helping me become the leader that I am. Without his encouragement I would not have started the PhD program and without his guidance I would not have finished.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

In the summer of 1988, a visionary principal telephoned a first year English teacher, Mrs. Streitmatter, to meet him at school as he had an important matter to speak with her about. When she arrived, full of apprehension as to the purpose of this meeting, she was greeted with the challenge to use a personal computer in her classroom. The principal assured her that student work would thrive through the use of this piece of equipment as an instructional tool. With all the courage she could muster the precarious teacher told the principal to take that thing out of her classroom as she would never use it. As a veteran teacher, over 20 years later, Mrs. Streitmatter, was the first in her school to incorporate the daily use of an interactive white board, expect her students to submit their written work through an email account, and create a blog for students to leave their literature responses (A. Collins & Halverson, 2009).

Mrs. Streitmatter was a skeptic who was not alone. Published in *Rethinking Education in the Age of Technology,* A. Collins and Halverson (2009) provided a list of quotes by Dave Thornburg and David Dwyer, who were two leading technology enthusiasts. These quotes represent a timeline of thinking toward change in education.

- From a principal's publication in 1815: Students today depend on paper too much. They don't know how to write on a slate without getting chalk dust all over them. They can't clean a slate properly. What will they do when they run out of paper?

- From the *Journal of the National Association of Teachers*, 1907: Students today depend too much upon ink. They don't know how to use a pen knife to sharpen a pencil. Pen and ink will never replace the pencil.
- From *Rural American Teacher,* 1928: Students today depend upon store bought ink. They don't know how to make their own. When they run out of ink they will be unable to write words or ciphers until their next trip to the settlement. This is a sad commentary on modern education.
- From *PTA Gazette,* 1941: Students today depend on these expensive fountain pens. They can no longer write with a straight pen and nib. We parents must not allow them to wallow in such luxury to the detriment of learning how to cope in the real business world which is not so extravagant.
- From *Federal Teachers,* 1950: Ballpoint pens will be the ruin of education in our country. Students use these devices and then throw them away. The American values of thrift and frugality are being discarded. Businesses and banks will never allow such expensive luxuries.
- From fourth grade teacher in an *Apple Classroom of Tomorrow Chronicles,* 1987: If students turn in papers they did on the computer, I require them to write them over in long hand because I don't believe they do the computer work on their own.
- From a science fair judge in *Apple Classroom of Tomorrow Chronicles*, 1988: Computers give students an unfair advantage. Therefore, students who used computers to analyze data or create displays will be eliminated from the science fair. (A. Collins & Halverson, 2009, pp. 30-31)

Educational trends in the 21st century are moving the focus away from teaching to learning. As educators begin to transition through this paradigm shift, they find themselves challenged to give up the traditional teaching methods for more learner-centered approaches. Altan and Trombly (2001) suggested that the learner-centered classrooms provide the opportunity for diverse learners to become accountable for their learning. The responsibility of the teacher is no longer to transfer information but to lead students on a journey to find accurate, relevant information for their individual academic growth.

School reform leaders have the arduous task of transforming educators skeptical of the use of technology into believers that technology presents a promising path (Christensen, 2008). The ethos of education is that the responsibility of trained teachers is to be the vessel for conveyance of knowledge to the students. This sentiment has been developed over centuries of teaching and will not easily be changed. Focus on university-level teacher training programs will need to alter their curriculum to include the integration of technology into content area instruction (Grabe, 2001).

One focus area drew government concern over the United States proposed failure to meet scienc and math proficiencies on standardized testing. Science, Technology, Engineering, and Math (STEM) education came to the forefront as a combined effort to join this shift in education. STEM educators were the first to realize the importance of using technology as a tool to support classroom instruction and engage students in learning (Kuenzi, 2008).

Numerous research studies have been conducted which indicate that engaged students are more likely to perform well academically (The Center for Comprehensive School Reform and Improvement, 2006). Student engagement, as defined by Newmann (1986), is “when students devote substantial time and effort to a task, when they care about the quality of their work, and

when they commit themselves because the work seems to have significance beyond its personal instrumental value" (p. 243). According to Wagner (2008), whether we like it or not, whether we are ready for it or not, mobile learning represents the next step in a long tradition of technology mediated learning—people can be offered more things to do with the mobile phones to which they are already attached and with which they are already reasonably competent.

Making the connection between student engagement and the use of cell phones as an instructional strategy is a natural progression. More than 70% of American high school students carry a cell phone (Common Sense Media, 2010). Therefore, a study is needed to determine the effectiveness of mobile devices as an instructional strategy in the classroom.

Purpose of the Study

The purpose of this study was to determine to what effect there are benefits to learning and teaching by using cell phone technology as an instructional tool. A. Collins and Halverson (2009) alluded to the fact that the current school system does little to develop the intrinsic motivation to learn. A. Collins and Halverson (2009) cited recent surveys which found that high school students are bored in school. In one study 50% of students reported being bored in all classes every day. Another study conducted with California 9th and 10th graders found that 82% of those students reported their school experience as boring and irrelevant.

As stated earlier, when students devote substantial time and effort to a task and care about the quality of their work, the work has significance (Newmann, 1986).

> Students who struggle in school spend hundreds of hours tweaking football rosters to meet salary cap requirements in *Madden* or editing parody videos on YouTube. Suddenly, when the drudge work of complicated tasks becomes contextualized and has

> new significance, students are more than willing to take the time to "get it right." (A. Collins & Halverson, 2009, p. 123)

A. Collins and Halverson (2009) went on to say that by understanding how new technologies can encourage children take responsibility for their own learning, society may help produce a generation of people who seek out ways to learn.

Wagner (2008) cautioned that technology in and of itself may not guarantee better learning. But when effectively deployed, technology can help focus attention while attracting and maintaining a learner's interest. By examining the use of cell phones in the classroom this study provides educators an additional strategy to engage students in their own learning.

Statement of the Problem

Cell phones were invented in 1973; however, at a cost of $3,500, they were out of reach for most individuals. Their original size was cumbersome and the available service was limited. As with all technology the cost lowered, the size dramatically decreased, and cell phone towers sprouted everywhere. Still, cell phones were not considered a problem in schools until after the Columbine school massacre in 1999. It was then that parents initiated the use of cell phones in schools as they wanted to be connected with their children at all times. The events of the September 11, 2001, attack on the World Trade Center further solidified the need for families to have instant communication. Safety was the primary reason mobile phones first became popular in the early 1990s. But did the highly publicized use of cell phones during the disasters prompt more people to consider cellular service for use in emergencies (Gillette, 2001)? Since that time more and more children have been given the responsibility, and the benefits of carrying a cell phone.

Schools have tried a myriad of policies and procedures to procure the use of cell phones in their learning institutions. When cell phones first became a problem, administrators looked for the easy answer and wanted to put in blockers and scramblers. They soon found these products were illegal in the United States. Some schools banned cell phones altogether. Some chose to allow students to keep phones, as long as they were turned off, in their lockers. Few schools are experimenting with the idea of allowing students to carry phones on their persons as long as they are turned off. The confiscation of cell phones used inappropriately is included in most school cell phone policies.

Taking the taboo out of cell phone use in schools is not as easy as the technology enthusiasts would like us to think. Skeptics have created a list of barriers that keep schools from embracing technology. According to A. Collins and Halverson (2009), the following barriers keep educators from preparing students for the 21st century because they are using 19th century technology: "cost and access, classroom management, what computers can't teach, challenges to instruction, authority and teaching, and assessment" (p. 37).

In addition to the above concerns, L. D. Rosen (2010) cited safety as a major concern educators have in keeping technology out of schools. A recent study of 500 district technology directors found that their number one concern, shared by more than three in four of the directors, was the safety of their students, including their regard for personal privacy (L. D. Rosen, 2010). L. D. Rosen quoted a young teacher from an interview:

> I learned about all this great stuff in my college classes, but it is just so hard to get anyone to agree what I am allowed to use in my classroom. I would love to tap into the students' love of social networks and set up some learning options but the administration, parents, and even other teachers keep screaming at me that it is not safe. They are so frightened

> that they won't even let the students access MySpace or Facebook from campus computers. (p. 179)

The problem then exists to convince educators that the merits of the use of cell phone technology outweigh the barriers currently in place.

Junco and Timm's (2008) study provided evidence that the use of technologies, including cell phones, does enhance student engagement. Foundations, major communication corporations, and university computer science departments have participated in wireless research studies for over a decade. This research has been predominantly set up to advance networking for the purpose of increasing world commerce. In 2005, Wireless Reach designed a case study used with the North Carolina Department of Public Instruction called Project K-Nect (Digital Millennial Consulting and Qualcomm Incorporated, 2007). This was the first project conducted in a U.S. school system through The Wireless Reach© initiative.

Project K-Nect was designed to focus on a specific population of at-risk 9th grade students who have (a) limited math proficiency as identified by standardized test results conducted by the selected school site, (b) limited or no access to a home computer, and (c) limited or no internet access at home. Each identified student was given the use of a Smartphone enabled with software that the classroom teacher controlled. Each student was given the opportunity to solve assigned problems through the mobile device to master a skill set aligned to the teacher's current lesson plan objective (Digital Millennial Consulting and Qualcomm Incorporated, 2007). According to Digital Millennial Consulting and Qualcomm (2007),

> Project K-Nect adds an entirely new dimension to the use of mobile computer in empowering individuals; it is a source that facilitates this innovative use of mobile

technology. This project is a ground-breaking investment in the future of our kids, and the contributions that they will make to society as adults. (p. 1)

Although studies such as Project K-Nect are beneficial to corporations with the ability to fund million dollar investments, relating the results are not meaningful to school districts and teachers who are financially strapped. Thus, additional studies would be beneficial in making the paradigm shift comfortable for those leading classrooms and prevent the use of cell phones in classrooms from becoming another sad commentary on modern education (A. Collins & Halverson, 2009).

Research Questions

Research questions provide a framework to help the researcher organize the study in order to give it direction, coherence, and relevance (Onwuegbuzie & Leech, 2006). The following questions were constructed to organize this particular study.

1. Is there a significant difference between STEM teachers and teachers of other disciplines in the perceived importance of integrating technology in their instruction?
2. Is there significant difference between STEM teachers and teachers of other disciplines in their ability to design and assess lessons supported by technology?
3. Is there a significant relationship between teacher's comfort level with technology use and their integration of technology to support their lessons?
4. Are levels of student engagement different based on the frequency of integration of technology?
5. Do the nine proficiency indicators serve as predictors of student engagement as reported by teachers?

Definitions

Applications (Apps). Refers tocomputer software designed to help the user perform specific tasks.

Cell phone. A hand-held mobile radiotelephone for use in a geographical region divided into small sections, each with its own short-range transmitter/receiver.

Electronic-learning (e-learning). Learning which is facilitated and supported via information and communications technology.

Mobile devices (also known as a handheld device, handheld computer, or simplyhandheld). Pocket-sized computing devices, typically having a display screen with touch input and/or a miniature keyboard.

Mobile learning. Any type of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies.

Smart phone. A cellular telephone with built-in applications and Internet access. Smart phones provide digital voice service as well as text messaging, e-mail, Web browsing, still and video cameras, MP3 player, video viewing, mobile computing.

Student engagement. Refers to a student's willingness, need, desire, and compulsion to participate in, and be successful in, the learning process promoting higher level thinking for endured understanding.

Wireless communication. Telecommunications systems which use some form of energy to transfer information without the use of wires.

Limitations

There is a limitation to the proposed study, which although important to address for the integrity of the research, is not indicative of the value of the outcomes. This limitation concerns the teachers involved in the study. Teachers were selected using a stratified random sampling method. Although this method provides for simplicity of the selection process and is accepted as fair (Brewer, 2007), it does not take into consideration the technology attitude and effectiveness of those selected to receive a survey. Because each respondent will have an individual comfort level with technology, generalizing would be difficult. However, despite this limitation the findings provide the researcher with valuable data and information to determine the effectiveness of the use of cell phone technology in the classroom and the need for further study.

Delimitations

I purposely determined the age of the students, the type of school, the location of the schools, and the lesson to be used in the study. This study will be conducted only in public, secondary schools. Teachers involved will be assigned to teach in Grades 7 through 12. There were no private or charter schools involved in the study.

In addition, I limited the survey respondents to 500, located in the middle west of the United States. This specific sampling and geographic parameter would make the generalization of this data inappropriate.

Summary

Changing traditional schooling to include the most up-to-date technology including cell phones has its challenges. One must transition through the barriers imposed by culture, ignorance, economics, and fear to open new opportunities for student learning. This study traverses these roadblocks and enables learners to take responsibility for their own learning.

In Chapter 2, the literature research for this study includes the history of cell phones in schools, student engagement, and teacher comfort level in using this new technology. The literature review will also document current studies which have been conducted in schools using cell phone technology. There are varying points of view on the subject of using cell phones for instruction, which will be presented. The content of Chapter 3 describes in-depth the research design and the methodology of the study. In the last two chapters the analysis of data comes together to create a picture of student engagement when cell phones are integrated in a lesson. At that point, I then report the findings and the implications of this study.

CHAPTER 2

REVIEW OF THE LITERATURE

The basis of this chapter is to review literature related to the study of teacher attitudes and behaviors toward the use of mobile technology, especially cell phones, as an instructional tool. Although much research can be found on teacher attitude and behavior toward technology in general, the origination of data on teacher attitude and behavior on cell phone use in the secondary school classroom is limited, however, emerging. The need for further study was detailed by Chao (2005) as she described the rapid growth of cell phone technology available to teachers and students.

The literature review focuses on four key areas: (a) historical use of technology in the classroom including the roadblocks associated with the implementation; (b) the digital generation, comparing the learning characteristics of digital native students, with the teaching strategies of digital immigrant teachers; (c) student engagement in relationship to technology in the classroom; and (d) current studies underlining the emergence of cell phone use as an instructional strategy in the classroom. The literature review outlined in Figure 1 illustrates the progression used to conduct this literature search.

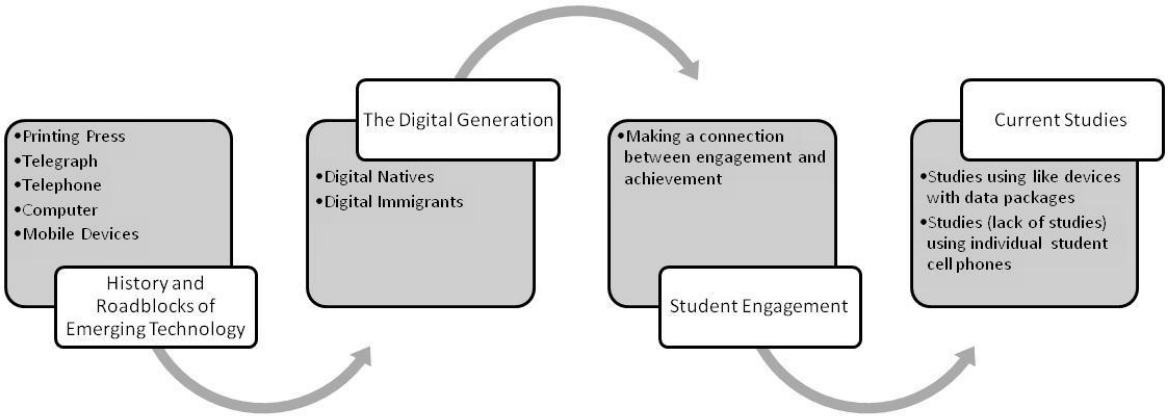

Figure 1. Literature review outline

Process for Searching and Choosing Articles Related to the Study

In order to assure a comprehensive search of relevant literature, a list of key terms were developed in order to limit the scope of the review. The established key words included mobile devices, cell phones, digital generation, smart phones, and mobile learning.

The literature review encompassed a plethora of sources including ERIC, ProQuest, professional journals, the 2011 as well as 2010 Florida Educational Technology Conference, personal interviews, dissertations, reference books, educational periodicals, and web searches.

The History of Technology in the Classroom

"What hath God wrought?", a simple message sent by telegraph by Samuel B. Morris on May 24, 1844, is said to have transformed America (Howe, 2007, p. 1). Due to the advent of the motion picture, Thomas Edison in 1913 was quoted as saying, "Books will soon be obsolete in the schools. Scholars will soon be instructed through the eye" (Cuban, 1986, p. 11). In January 2007, Steven Jobs, CEO of Apple, declared "a revolutionary and magical product" (as cited in Kobie, 2008, p. 7) when the iPhone was revealed to the world.

Freud (1989) expressed the importance of new technologies to individuals in the American society:

> During the last few generations mankind has made an extraordinary advance in the natural sciences and in their technical application and has established his control over nature in a way never before imagined. One would like to ask: is there, then no positive gain in pleasure, no equivocal increase in my feeling of happiness, if I can, as often as I please, hear the voice of a child of mine who is living hundreds of miles away or if I can learn in the shortest possible time after a friend has reached his destination that he has come through the long and difficult voyage unharmed? If there has been no railway to conquer distances, my child would never have left his native town and I should need no telephone to hear his voice. (pp. 39-40)

Although the advent of the telephone has brought peace to individuals in their personal lives, researchers contend that the divide between technologies used in homes and in schools is getting wider (J. Collins, 2001). The reality is that the influence of technology will only grow, so, as leaders in education, we need to create educational experiences that mirror life beyond the schoolhouse (Young, 2011).

The launch of the IBM5150 in August 1981 not only created a benchmark for personal computing but also marked the birth of a new generation, a generation that would grow up and socialize in a digital environment, America's first digital generation (Harwood & Asal, 2007). The phenomenon caught on in 1982 when more than 100,000 computers were in America's schools. By 1985 each school in the country had at least one machine (Cuban, 1986). These new technologies, although infiltrating our schools, were not incorporated into the core curriculum of the general classroom, but used as stand alone learning experiences. Schools

scheduled tech prep courses, computer labs, computer literacy, and programming courses (A. Collins & Halverson, 2009). A. Collins and Halverson (2009) went on to say,

> Technologies used at work and at school are getting further and further out of sync, and enthusiasts think that this gap between the old and the new technologies will force schools to adjust and incorporate new methods into the core practices of teaching and learning. (p. 10)

B. Skinner (1958) criticized conventional instruction for the lack of innovation in a 1958 document where he wrote that teaching machines encourage learners to take an active role in the instructional process. He went on to say, "The effect upon each student is surprisingly like that of a private tutor" (B. Skinner, 1958, p. 572).

Twentieth century developmental psychologist Jean Piaget presented educators with a framework for cognitive development (Huitt & Hummel, 2003). To incorporate his framework in educational technology, he forecasted the need for teacher training to change radically, and in 1950 alluded to the fact that schools will be "totally different than they are today" (as cited in Saettler, 2004, p. 80). Through his study of American educational technology, Saettler (2004) concluded,

> From the foregoing survey of selected instructional theories and methods, it should be clear that almost every significant system of instruction, from the time of Comenius to Piaget, has left a residue of theory and technique in current educational technology. It is also clear that a scientific technology of instruction has developed at a painfully slow rate and, simultaneously, that there is a general lack of agreement upon concepts of educational technology. (p. 81)

Although the telegraph is now outdated it did much to revolutionize our world. Such an invention changed the way we communicated. Its inception also set forth a series of improvements that culminated with Alexander Graham Bell uttering his now famous words in 1877, "Mr. Watson—come here—I want to see you" (as quoted by Alfred, 2008). That first telephone is far from the 2007 Invention of the Year, iPhone (Blokdijk, 2008); however, it brought a new technology that has yet to infiltrate the instructional methods in education.

Thomas Edison would be disappointed given his 1913 prediction that textbooks would be obsolete has not yet come to fruition (Cuban, 1986). In 1911, Edison released a series of historical films produced specifically for the classroom. He was convinced that the film industry would revolutionize education.

> I believe that the motion picture is destined to revolutionize our educational system and that in a few years it will supplant largely, if not entirely, the use of textbooks.I should say that on the average we get about two-percent efficiency out of schoolbooks as they are written today. The education of the future, as I see it, will be conducted through the medium of the motion picture where it should be possible to obtain one hundred percent efficiency. (Edison as cited in Cuban, 1986, p. 9)

Walk into any classroom in America and you will see textbooks, on six-year cycles for renewal, used as the cornerstone of learning.

Software and Information Industry Association (SIIA) completes a yearly survey to track the progress on Vision K-20, a technology-based initiative for educational framework in K-12 school, universities and colleges (Vision K-20, 2010). The goal of SIIA is to increase student engagement and achievement, provide equity and access to new learning opportunities, document and track student performance, empower collaborative learning communities,

maximize teaching and administrative effectiveness and build student proficiencies in 21st Century skills (Billings, 2010). The results of the most recent survey detail slow growth of overall less than 1% improvement in schools to help students acquire 21st Century skills (Flickinger, 2010).

Maftoon (1982) characterized this slow growth in a statement about teachers and changes:

> It has been found that teachers reject or at least resist change because of failure to recognize the need for improvement, fear or experimentation, unwillingness to give time, and disillusion or frustration with past experiences. In addition, teachers traditionally tend to be conservative and usually will not be impressed by the results of investigations and research or new theories of education. (p. 45)

In 1977, Polley presented a paper at the National Institute of Education conference in which he proclaimed, "The history of modern education is littered with the trash of technology left behind by unrealistic purchases, naïve users, and vendor representations working on a quota system" (as cited in Albright, 1992, p. 1). This statement is supported in Cuban's (1986) recollection of early technology when school boards purchased machines, were supported by administrators who installed the machines, and then teachers did their best to use the new technology. To the outside it appeared that technology was being incorporated into instruction. However, the truth was that the technology was rarely used, relegated to an occasional appearance as an add-on to a lesson. By 2005, 94% of public schools were connected to the Internet, with one instructional computer with an Internet connection for every 3.8 students (National Center for Education Statistics [NCES], 2006). Yet, the NCES (2006) report goes on

to describe the use of computers not as an innovative change to instruction, but as another method to deliver a lecture, practice skill and drill, and use as an overhead.

It has been documented that the most rapid growth in technology in education was in the 1990s and early 2000s with the addition of computers in schools. After the influx of the computer, schools lagged behind the rest of society with following the trends in technology (Grabe, 2001). One of the most serious obstacles for integrating technology fully into instruction is the lack of professional development for teachers (Fatemi, 1999; Killion, 1999; Office of Technology Assessment, 1995; Panel on Educational Technology, 1997; Schrum, 1999).

"We've been trying to talk teachers into integrating technology into the classroom for 30, maybe 40 years. It's not working," (as cited in Boss, 2008, p. 18) said Sylvia Martinez president of Generation YES. Boss contended, through her research of teachers unions, when teachers understand that technology improves learning they are enthusiastic about incorporating technology, however unprepared.

Professional development has not been the only barrier to effective technology use in schools. There is an overriding, yet questionable, concern about equitable student access to technology. The term *digital divide* first appeared in the 1990s as computers emerged in homes and schools. The premise was that there would be social exclusion due to a gap between people who had access to technology and those who did not. The 2003 NCES report confirmed that there was indeed a divide along demographic and socioeconomic lines in regards to computer and Internet accessibility (DeBell & Chapman, 2006).

In *Growing Up Digital*, Tapscott (2009) penned, "The wealthy in America are information rich. The poor are information poor" (p. 4). The school then becomes the conduit to correcting this digital divide (Harwood & Asal, 2007). Harwood and Asalgo (2007) challenged

teachers to ensure that the digital underclass does not graduate without the technology skills needed to succeed in our contemporary society.

Elliott Soloway (as cited in Nagel, 2011), a professor at the University of Michigan, suggested that within five years mobile handheld devices will be a part of learning for every American student in grades K-12. "Smart phones are the one technology that can eliminate the digital divide. Given the cost of the device, it is very conceivable that every child, rich or poor, can have one 24/7" (Soloway as cited in Nagel, 2011, p. 2).

Middleton (2011) integrated the use of cell phones in her instruction with 7th grade students for the past three years. She claimed the digital divide is not a barrier for cell phone use in schools. Each year she surveys her students on their access to cell phones and to the type of services their phones provide. She is currently teaching in a school with 65% free and reduced status. Of the 70 students enrolled, 68 have their own cell phones. The students' phones were equipped with call and text-only service through fully functioning data packages. Middleton (2011) is careful to plan cell phone lessons that incorporate the technology students bring from home.

The integration of the cell phone into the classroom has been marked with controversy. From the introduction of cell phones in students' backpacks following the Columbine school massacre in 1999 through the release of the iPhone 4G in 2010, there has been little impact on education. The threat of cheating, texting, and distractions have prevented administrators from allowing cell phones to be used in schools (Kolb, 2011).

During the past 12 years a focus in schools regarding cell phones has been finding the best policies to prohibit them. Prior to cell phones, pagers entered school buildings and were quickly banned due to their perceived connection with gangs and drug activity (Trump, 2007).

As the president of National School Safety and Security Services, Trump (2007) advised schools not to succumb to the parental and student pressure of allowing cell phones to be carried in school. Trump (2007) said, "From an educational perspective, cell phones primarily present another disruption to the educational environment" (para 4).

The leader of the American Association of Policy Services, Dr. Willaim Scharffe, agreed that cell phones are a problem. "The main concern is prohibiting use during instructional time and not disrupting the school atmosphere. As the cell phone industry improved the product; it became more problematic for schools" (DeLisio, 2007, para. 3).

Skeptics argue that new technologies will not change schools. What they will do is disturb the equilibrium of core practices should technology be forced into the classroom (A. Collins & Halverson, 2009). Christensen (2008) argued that in order for school reform to finally happen, disruption is key.

Selwyn and Gorard (2003) suggested that although schools have been resistant to the use of fixed technologies such as computers and televisions there is now a challenge facing educational institutions with the growing ownership and use of mobile telephones. Selwyn and Gorard went on to say that schools have been caught up in the debate over misuse of mobile phones without fully considering the implications that mobile technologies could bring to learning.

Throughout history technology has been introduced with a promise to change learning. Yet, the schools of today resemble their counterparts of yesteryears with rows of desks, textbooks, teachers in the front of the room, and students waiting to be inspired. The incorporation of technology in the classroom has yet to catch up with the evolution of the technology itself. The Belgian Nobel Laureate, Maurice Maeterlinck, once wrote, "At every

crossway on the road that leads to the future each progressive spirit is opposed by a thousand men appointed to guard the past" (as cited in Christensen, 2008, p. 112).

Students, tools, and times have changed. Prensky (2005) contended that educators have slid into the digital age without doing things any differently than in the past. Prensky urgently confronted educators; it is time to raise their heads and observe the emerging new landscape. Our students once were little replicas of us but that is no longer the case. We have been entrusted with the stewardship of our students and it is time we provide a 21st century education (Prensky, 2005).

The New Learner

Montgomery (2007) referred to students today as "kids who don't remember a time without the constant connectivity to the world" (p. 34). Tapscott (2009) termed the new generation of learners as the *Net Generation*. He described children born after 1990 as bathed in bits of technology so much so that they think it is natural. L. D. Rosen (2011) identified the generation further through his research. His nomenclature of iGeneration is commonly used to describe the technologies popular with the generation and the individualized activities that are available on these technologies.

Using a play on words, Educational Leadership editor, Marge Scherer (2011), titled the February 2011 issue *Teaching Screenagers.* Throughout the issue she used this catchy term when referring to today's learners. Prensky (2001) is credited with coining the term *digital natives* when referencing kindergarten through college learners. Regardless of the term used to describe the students, there is consensus that the generation of learners who have grown up with technology presents challenges for educators.

L. D. Rosen (2010) researched the idea of "TechnoCoccoons" (p. 30). L. D. Rosen described families who alienate themselves from one another as they retreat to their bedrooms to spend time with technology. Children from birth on have access to televisions and computers in their bedrooms, iPods or MP3 players, cell phones, video game consoles, and handheld video games.

Gergen (n.d.) discussed his oxymoron theory of absent presence as he described the scene of walking into a room and finding family, friends, or colleagues present but conspicuously absent as they are absorbed in technology, be that a book, a computer, or a phone. Perhaps more important than the type of technology children have access to is the time they spend using the technology. L. D. Rosen (2010) collected data to show the time children spend with the various technologies. Table 1 reflects this timeframe.

Table 1

Time Children and Teens Spend Using Technology and Media Each Day (Hours: Minutes)

	6 Months-3 Years	4-8 Years	9-12 Years	13-15 Years	16-18 Years
Internet	0:04	0:27	0:59	1:58	2:24
Computer (not on-line)	0:02	0:23	0:57	1:44	1:59
Email	0:01	0:06	0:26	1:08	1:19
IM/Chat	0:01	0:05	0:28	1:24	2:16
Telephone	0:08	0:17	0:43	1:07	1:50
Texting	0:01	0:07	0:46	2:19	3:32
Video Games	0:18	1:32	2:07	1:20	1:17
Music	0:03	0:42	1:24	2:49	3:33

Table 1 (continued)

	6 Months-3 Years	4-8 Years	9-12 Years	13-15 Years	16-18 Years
Television	1:30	1:56	1:56	1:58	2:10
TOTAL	2:35	5:35	9:46	15:47	20:20

Note. Technology owned by children and teenagers (L. D. Rosen, 2010, p. 31). Reprinted with permission.

L. D. Rosen (2011) suggested that a connection can be made between after-school learning and school-based learning with technology being the constant. That connection had not been made as indicated in the Neilsen Company (2009) report on *How Teens Use Media*. A disconnect was revealed in the data that 77% of teens own their own mobile phone and an additional 11% had access to borrow one. Teens used their phones to text at an average rate of 2,899 times per month. These same teens reported that 93% of their schools had restrictions on their mobile phone use (Nielson Company, 2009).

Prensky (2001) believed that students have changed radically and that they are no longer the learners our educational system was designed to teach. He described them as the first generation to grow up with technology and that they have spent their entire lives surrounded by cell phones, computers, video games, digital music players, and video cams. The change has not just been what this generation is surrounded by but their thinking has actually transformed.

Just as people who grow up in different cultures think differently, so too do digital natives. These students are accustomed to multitasking, random-access, twitch-speed, graphics-first, fun, fantasy, MTV, connected, active, and Internet. Students are bored with traditional education (Prensky, 2001). The students know what they want and educators are generally

ignoring these facts. Prensky (2010) developed a list of student wants that he admitted could be looked at as narcissistic or unrealistic. He warned that to continue to ignore the students is a big mistake.

1. They do not want to be lectured to.
2. They want to be respected, to be trusted, and to have their opinions valued and count.
3. They want to follow their own interest and passions.
4. They want to create, using the tools of their time.
5. They want to work with their peers on group work and projects (and prevent slackers from getting a free ride).
6. They want to make decisions and share control.
7. They want to connect with their peers to express and share their opinions, in class and around the world.
8. They want to cooperate and compete with each other.
9. They want an education that is not just relevant, but real. (Prensky, 2010, p. 2)

In their research Oblinger and Oblinger (2005) found that what students from the Net Generation really want is to learn. These students believe that technology is essential to that learning because it is part of their world, it is embedded in society, it makes things faster, abstract concepts are easier to grasp, it allows them to research any topic, and connects them with others who can help them learn. These same students admit that technology alone is no answer to education. They understand that learning is based on motivation and without teachers that motivation would cease to exist, that computers will never replace humans, that teachers are vital to the learning process, and that a major part of school is building social skills that cannot be replicated through technology.

These digital natives are not only students but consumers. Montgomery (2009) described the 2003 Yahoo! sponsored *Born To Be Wired* summit. Six teenage bedrooms were brought from their suburban homes and recreated at the summit site. Scattered among the bedroom replicas were technological paraphernalia. During the summit market researchers converged on the makeshift bedrooms, where the teenagers themselves were lounging, and interviewed the teens who were eager to share their wants. Throughout the remainder of the summit numerous sessions, displays, and workshops were attended by youth market researchers.

Although marketing to children was not a new concept, the product was distinctly different from the sugared cereals advertised during Saturday morning cartoons watched by now aging Baby Boomers. As parents were pressured to "keep up with the Joneses" and purchase the latest technology for their children, schools began to see these handheld digital devices enter their classrooms.

Postman (1985) suggested that the digital generation was not the first to be *sold* technology as a substitute for education.

> We now know that "Sesame Street" encourages children to love school only if school is like "Sesame Street." Which is to say, we now know that "Sesame Street" undermines what the traditional idea of schooling represents. Whereas a classroom is a place of social interaction, the space in front of a television set is a private preserve. Whereas in a classroom, one may ask a teacher questions, one can ask nothing of a television screen. Whereas school is centered on the development of language, television demands attention to images. Whereas attending school is a legal requirement, watching television is an act of choice. Whereas in a classroom, fun is never more than a means to an end, on television it is the end in itself. (Postman, 1985, p. 143)

In an interview with Karen Parker, Program Manager for Google Appinventor, she said the goal of the education team at Google is to "open up the black box of technology" (K. Parker, personal communication, November 13, 2010). She indicated that although students are the best thinkers in terms of technology in our classrooms the focus has shifted from teens as consumers of technology to creators of technology. She spoke for an organization whose members believe that the growing use of cell phones in education will have a huge impact on how students learn.

Teachers of the New Learner

While researching the new learner it would be negligent not to look at who is charged with teaching this generation of students. Prensky (2001) contended that the biggest problem facing education today is not the student, but the teacher. He drew reference to a serious scenario of digital immigrants standing in front of a classroom trying to engage digital natives. Prensky (2001) describes digital immigrants as those not born in the digital world. The positive aspect is that although digital immigrants think differently, speak differently, and act differently than the digital natives they can learn new skills.

The acquisition of these skills does not come easy. In a 1999 study, 60% of teachers across the United States claimed to receive five hours or less of technology training each year. The purpose of this training was not to transform instructional styles or to enrich curriculum but for learning and practicing technical skills (Becker, 1999). A decade later in the Teachers' Use of Educational Technology in U.S. Public Schools study, 13% of teachers reported spending zero hours, 53% reported 1 to 8 hours, 18% reported 9 to 16 hours, 9% reported 9 to 16 hours, and 7% reported 33 or more hours spent in professional development on the use of technology (Gray, Lewis, & Thomas, 2010).

At the 2011 National School Board Association conference, presenter Ann McMullen shared with the audience the analogy of Captain Kangaroo teachers teaching Sesame Street students. Her explanation came from the digital immigrant teachers who as children sat quietly in front of the black and white television for a half hour as Captain Kangaroo had a one-sided conversation with a mute bunny rabbit, Mr. Green Jeans would wander through the set, and Tom Terrific wore a dunce hat. She compared that scene to the one where digital natives interacted with the colorful characters of Sesame Street. This supported her theory that digital immigrants teach the way they learned (McMullen, 2011).

Although there is controversy in the research of who coined the term STEM (Science, Technology, Engineering, Math), those in this teaching discipline have integrated technology by virtue of their subject area long before teachers in other disciplines (Ray, 2010). In an effort to narrow the achievement gap in middle school science and math, Marino of Washington State University developed a Universal Design for Learning (UDL) framework specifically for use with STEM curricula (Family Center on Technology and Disability [FCTD], 2010). When asked if his technology-rich UDL curricula could be effective with non-STEM subjects, Marino stated "My research has been so focused on tools that are effective for science, technology, engineering and mathematics that it would be impossible for me to say definitively that these tools would work in other contexts" (as cited in FCTD, 2011, p. 6).

Student Achievement

There are numerous studies that suggest increased student achievement when technology is integrated into instruction (Bain & Ross, 2000; Boster, Meyer, Roberto, & Inge, 2002; Koedinger, Anderson, Handly, & Mark 1997; Mann, Shakeshaft, Becker, & Kottkamp, 1998). One such study was a longitudinal study covering eight years at Brewster Academy in New

Hampshire (Bain & Ross, 2000). The study showed that students who have technology integration in their instruction scored a combined 94 points better on the SAT I than students who had no technology instruction on the same test (Bain & Ross, 2000).

Although the ultimate goal of technology integration into instruction is to improve student achievement, it is the teacher's attitude toward and efficiency with technology that are essential to make this happen (Rakes & Casey, 2002). Teachers' pedagogical beliefs may stand in the way of full integration of technology into instruction (Ertmer, Ross, & Gopalakrishnan, 2007). Teachers have long used tools to help them teach a concept. Now that the tools have transformed from chalk, grease pens, and dittos to computers, whiteboards, and cell phones, teachers are challenged as never before. This challenge comes not from the tool but the information that can be garnered from the tool (Pecorino, 2004).

The research shows that student achievement and motivation is influenced by collaboration among teachers and collaboration among students (Marzano, Marzano, & Pickering, 2003). Collaborative learning has been identified as one of Marzano's effective teaching strategies. Twidale, Nichols, and Paice (1996) indicated in their research that there is better social interaction, more motivation, and higher student performance when collaborative learning is a part of the curriculum. McLaughlin and Talbert (1996) found that effective high schools were characterized by professional collaboration. Gains in student achievement were noted in a collaboration study by Little (1990) that included higher quality solutions to questions and increased self-efficacy.

In action research, Wilson reported that students in her on-line Physics class covered more material and performed at a higher level than student in her traditional classroom. She attributed this to the collaboration among students helping one-another rather than relying on her,

as the teacher, to provide them with problem solving strategies (T. Wilson, personal communication, December 21, 2011). To support Wilson's claim, Kay and Honey (2005) developed Information and Communication Technology Literacy (ICT) skills which tie technology to collaboration. The ICT literacy skills enable students to analyze information, communicate, think critically, problem-solve, and collaborate.

Future Teachers

With the emergence of digital natives as pre-service teachers, Prensky (2005) suggested that teachers' attitudes and skills will no longer be a problem. Other studies gave similar indications of teachers fully embracing the use of technology in the classroom (NetDay, 2006; Rainie, 2006; Rideout, Foehr, & Roberts, 2005; Tapscott, 1998). Yet, universities are finding that student technology use varies and many are reluctant technology users (Cameron, 2005; Kvavik, Caruso, & Morgan, 2004).

In regards to pre-service teachers' beliefs in using technology, Lei (2009) surveyed 70 incoming freshmen teacher education majors at a large northwestern university. Table 2 provides the results of her survey. Through her study she found four areas of concern with pre-service teachers and the use of technology in the classroom. The digital native pre-service teachers valued new technologies but felt the need to preserve traditional teaching methods.

Table 2

Beliefs, Confidence, and Interest in Technology

	Strongly Agree/ Agree	Neutral	Disagree/ Strongly Disagree
Computers are generally reliable.	92.9%	7.1%	0.0%
Technologies can help me tech better.	82.8%	17.2%	0.0%

Table 2 (continued)

	Strongly Agree/ Agree	Neutral	Disagree/ Strongly Disagree
Technologies can help my students learn better.	79.3%	20.7%	0.0%
I do well with compute technologies.	48.2%	31.3%	22.5%
I can solve most of the problems when my computer doesn't work.	13.8%	51.7%	34.5%
I am interested in computers and related technologies.	55.6%	44.4%	0.0%
I am interested in learning new technologies.	58.6%	31.0%	10.4%
I am interested in learning technologies that will help me in the future.	100.0%		

Source. Lei (2009). Reprinted with permission.

These digital pre-service teachers felt strongly that their future students should learn basic skills so that they would not have to rely on technology. The pre-service teachers were also concerned that technology should be used in moderation and that their future students do not become dependent on the technologies. Another concern Lei (2009) found was that the pre-service teachers looked at technology as a *double-edged sword*. These future teachers thought although integrating technology in lessons could help some students learn, it could also become a distraction. Finally, the pre-service teachers felt that their future students' age should be considered when incorporating technology in the classroom. They had a strong belief that elementary students should build basic skills prior to being focused on technology (Lei, 2009).

L. D. Rosen (2010) insisted that pedagogy dictates that curriculum and content cannot be replaced by technology. At the same time he implored educators to make the changes necessary to successfully teach the new learner.

> The time has come for us to put together the solid, research based ideas to form a coherent plan for supercharging education. We now have the know-how to provide an educational experience both inside and outside the classroom that is motivating, captivating, and engaging. We can no longer ask our children to live in a world where they are immersed in technology in all parts of their lives *except* when they go to school. We *must* rewire education or we risk losing this generation of media-immersed, tech savvy students. (L. D. Rosen, 2010, p. 226)

Student Engagement in Relationship to Technology

"We have to speak the language young people understand. And that language is technology" (E. Begley Jr., personal communication, January 14, 2010). Begley insisted to the audience at the 2010 Florida Education Technology Conference that in order for students to hear the message we are sending it must be delivered in a way that is engaging.

Student engagement has long been studied under the guise of involvement, desire, willingness, compulsion, and need (Bomia et al., 1997). Just as important as engagement, researchers have found that student motivation is key to success in the classroom (Beeland, 2001). Motivation comes in two distinct forms: intrinsic or extrinsic. Intrinsic motivation is inherent and comes from within (Csikszentmihalyi, 1990, 1996; Schweinle, Meyer, & Turner, 2006). Extrinsic motivation comes from an outside source prodding or enticing the learner (Gottfried, Fleming, & Gottfried, 2001; Reeve, 2006; Schiefele, 1991).

The opposite spectrum of engagement is disengagement, often referred to as disaffect (Connell & Wellborn, 1991; E. A. Skinner, Kindermann, & Furrer, 2008). The "slow process of disengagement from school" (Bridgeland, Dilulio, & Morison, 2006, p. 11) has been noted as a contributing factor to students dropping out of school.

As defined by E. A. Skinner and Belmont (1993),

> Engagement versus disaffection in school refers to the intensity and emotional quality of children's involvement in initiating and carrying out learning activities. Children who are engaged show sustained behavioural [*sic*] involvement in learning activities accompanied by a positive emotional tone. They select tasks at the border of their competencies, initiate action when given the opportunity, and exert intense effort and concentration in the implementation of learning tasks; they show generally positive emotions during ongoing action, including enthusiasm, optimism, curiosity, and interest. The opposite of engagement is disaffection. Disaffected children are passive, do not try hard, and give up easily in the face of challenges [they can] be bored, depressed, anxious, or even angry about their presence in the classroom; they can be withdrawn from learning opportunities or even rebellious towards teachers and classmates. (p. 572)

Measuring student engagement has been a well-researched and documented topic. Focus has been placed on student self-report as one of the methods to best measure engagement (Betts, 2010; Osborne, 2001; Quinn, Gruenert, & Valentine, 1999; Yazzie-Mintz, 2010). The 2009 High School Survey of Student Engagement (HSSSE) was completed by 42,754 students in which they were asked questions to analyze cognitive/intellectual/academic engagement, social/behavioral/participatory engagement, and emotional engagement (Yazzie-Mintz, 2010). The students were asked to rate instructional methods to the extent of how these methods

engaged or excited the students. For the first time since the 2004 inception of the HSSSE, students were asked to rate projects and lessons involving technology. In this category, 55% of the students responded that they were either to some degree or very much engaged and excited by the use of technology. Of the ten instructional methods listed on the survey only two, "discussion and debate" and "group projects," elicited a higher positive response than technology (Yazzie-Mintz, 2010).

Marzano, Pickering, and Pollock (2001) identified nine instructional strategies deemed most important to improve student achievement. Brabec, Fischer, and Pitler (2004) concluded that although technology alone exhibited little effect on student achievement, it was a powerful tool to support Marzano's et al. nine categories of teaching strategies.

1. Identifying Similarities and Differences
2. Summarizing and Note Taking
3. Reinforcing Effort and Providing Recognition
4. Homework and Practice
5. Nonlinguistic Representations
6. Cooperative Learning
7. Setting Objectives and Providing Feedback
8. Generating and Testing Hypotheses
9. Cues, Questions, and Advance Organizers (Brabec et al., 2004, pp. 7-8)

Teacher motivation and skills, parental involvement, and effective use of technology are all factors that influence student motivation. When technology is used in innovative ways the environment is set to improve learning and teaching (Wishart & Blease, 1999). Meeting the

needs of the various learning styles of students is enhanced through the use of technology (Smith & Blankinship, 2000).

Skeptics contend that in classrooms where technology has been introduced, student engagement increases due to the novelty of the technology tool. Sandholtz, Ringstaff, and Dwyer (1997) chose to research the long-term effect of technology in the classroom. The results indicated that the enthusiasm shown by students motivated others in the class. Teachers reported that students did not tire of using the technology. Students consistently chose technology-based assignments over that of paper and pencil when given a choice. Teachers noticed that time-on-task increased when students were using technology for their assignments. Finally, students volunteered their free time during lunch and recess to work on their assignments once the technology component was introduced (Sandholtz et al., 1997).

Kearsley and Shneiderman (1999) concluded that the role of technology is to facilitate all aspects of engagement. They believed that the vast array of technology tools available allow students to do sophisticated and complex tasks. In addition, they found that technology provides a milieu that fosters creativity and communication indicative of engagement (Kearsley & Schneiderman, 1999).

Wagner (2008) described learning as a deeply personal act that is reinforced when the experiences surrounding the learning are relevant, reliable, and engaging. She stated further that although technology itself is not a guarantee that learning will take place, it does help maintain the learner's interest.

In a study conducted at the University of Alabama, researchers surveyed students on specific feelings toward integration of technology into the classroom (Alexiou-Ray, Wilson,

Wright, & Peirano, 2003). An overwhelming majority (83; *N* = 92) responded that learning was more interesting when technology was integrated (Alexiou-Ray et al., 2003).

In 1998, a set of technology standards for students was developed by the International Society for Technology in Education (ISTE). These standards, called the National Educational Technology Standards for Students (NETS-S), were based on ethical behavior, the tools, and the specific technology tasks. In Table 3 the original standards are compared with the updated standards released in 2007. The revision clearly shows the move from competency in the use of technology to learning through technology (Schrum& Levin, 2009).

Table 3

Original and Updated National Technology Standards for Students

ISTE NETS-S 1998 Standards	ISTE-NETS 2007 Standards
1. Basic Operations/Concepts	1. Creativity & Innovation
2. Social, Ethical, Human Issues	2. Communication & Collaboration
3. Technology Productivity Tools	3. Research & Information Literacy
4. Technology Communication Tools	4. Critical Thinking, Problem Solving, & Decision Making
5. Technology Research Tools	5. Digital Citizenship
6. Problem Solving/Decision Making	6. Tech Operations/Concepts

Source. Schrum and Levin (2009).

Similarly the ISTE created standards for teachers in the use of technology as shown in Table 4. The original standards, much like the students' first list, focused on the planning and use of the technology tools, whereas facilitating student engagement and motivation in learning are the heavy emphasis in the adaptation of the standards (Schrum & Levin, 2009).

Table 4

Original and Updated Technology Standards for Teachers

ISTE NETS-S 1998 Standards	ISTE-NETS 2007 Standards
1. Technology Operations and Concepts	1. Facilitate and Inspire Student Learning and Creativity
2. Planning and Developing Learning Environments and Experiences	2. Design Digital-Age Learning Experiences and Assessments
3. Teaching, Learning, and Curriculum	3. Digital-Age Work & Learning
4. Assessment and Evaluation	4. Promote Digital Citizenship & Responsibility
5. Productivity and Professional Practice	5. Engage in Professional Growth & Leadership
6. Social, Ethical, Legal, and Human Issues	

Source. Schrum and Levin (2009).

Active learning has in the past been referred to as the learning that involves physical activity. With the immersion of technology in the classroom, that definition is evolving to where *active* now refers to the mental behavior of the student. In technology-rich classrooms students are taking a more active role in their learning and the teacher's role is shifting from dispenser of knowledge to facilitator of learning (Grabe, 2001). This shift in instruction, while proving to increase student learning, frustrates traditional teachers. They realize that their once perceived educational goals will now become obsolete. Yet, the opportunity exists for these teachers to adopt active learning and constructivist practices (Grabe, 2001).

"Technology is all about engagement. Watching the intense looks on our teens' faces as they text, Skype, Facebook, and juggle a dozen websites at a time, we can clearly see that they

are engaged" (L. D. Rosen, 2011, p. 14). Engagement should be about brain activity, not a focus on entertainment. To measure the worth of the technology in a lesson along with engagement the onlookers should find evidence of relevance and personalization (Scherer, 2011).

In the study of pedagogy, research supports that students learn in three ways. Students learn by seeing, learn by doing, and learn by hearing (Denig, 2004). Subsequently students learn best when two methods are combined. In looking at cell phones specifically, the latest smart phone employs all three methods of learning (Center for Digital Education, 2008).

"Integrating their favorite device into learning can get students more engaged with classroom content" (Kolb, 2011, p. 38). Mobile learning devices, such as cell phones, make authentic learning possible and give students the incentive to take personal ownership in their learning (McCaffey, 2011). In a yearlong action research project, teacher Matt Cook integrated the use of cell phones in his fifth-grade classroom. At the end of the study he noted tremendous growth in students' engagement, excitement, and confidence (as cited in Kollie, 2011). Key findings from a *Survey of Online Learning Preparedness* (N = 2,200) indicated that 89% responded that "students are positively engaged by the use of technology in the learning environment" (Manzo, 2009, p. 5) and 96% responded "students demonstrate improved learning, performance, and /or achievement when technology is integrated into their curriculum" (Manzo, 2009, p. 5).

Research is filled with examples of the relationship between student engagement and collaboration. One such example by Tinto (1997) shows that the development of peer support networks, which encourage participation and attendance, are results of collaborative learning activities. He described collaborative learning as a way to lead to improved quality of learning including deeper and richer, where student not "only learn more but better" (Tinto, 1997, p. 614).

Engaged learning presents challenges for both the teacher and the learner because it simply does not just happen. Facilitation of the transition between engaging the learner through the use of technology and the mindset reinforced by traditional lecture-based learning takes planning. Although engagement is not a new approach to learning, juxtaposing engagement with technology is (Conrad & Donaldson, 2004).

Change in Education

"New technologies, when coupled with well-planned and supportive implementation, can facilitate radical change" (Hobbs & Christianson, 1997, p. 87). Although not the change Hobbs and Christianson envisioned in 1997, cell phones in the classrooms are emerging as an attractive alternative to enhance active learning (Lindquist et al., 2007).

DeLorenzo (2009) blogged that industrial-age educational systems failed to focus on educating the student based on individual needs and focused more on predesigned industrial skills which met the employment needs of society. He continued that attitudes in education are changing. Although there are still standardized curriculums, there is better understanding that the learning needs of each individual student vary. He suggested that using educational applications (apps) be used to customize learning for each individual student (DeLorenzo, 2009).

Apple™ has over 500,000 apps available for download at this time with 8% of those being specifically built for education (Chen, 2011). Android™ is following with over 50,000 apps, 60% of which are free (Dawson, 2010). The director of educational technologies at Watershed School in Boulder Colorado reported,

> In the course of less than six months Google Apps for Education has become the technological center of nearly all operations at The Watershed School. Students are using apps on a daily basis for their email, 98% of all document creation (by both students and

> faculty) is in Google Docs, and all school administration occurs via apps. (Pavicich, 2008, para. 7)

In a report by the Joan Ganz Cooney Center the use of mobile apps was researched and five educational conclusions were reported (Shuler, 2009). The highlights were that mobile apps encourage anywhere, anytime learning, reach underserved children, improve 21st century interactions, fit with learning environments and enable a personalized learning experience (Shuler, 2009). The report uncovered a lagging use of mobile devices in learning and suggested a behavioral change by education. This change needs to move educators' debates from whether to use these devices to understanding how and when they would best be used for learning (Shuler, 2009).

Research Projects and Studies

In reviewing studies and projects using cell phones in the classroom, three commonalities emerged. First, it was noted that a majority of the studies were perpetuated by industry. Critics recognized this antic as a blatant, self-serving plan to infiltrate the educational market for profit. On the contrary, proponents saw the efforts as no different from computer companies marketing their wares in the 1980s (Richtel & Stone, 2009). One cannot question that what has come from the research is information benefiting teachers and students. The reports provide powerful enlightenment on incorporating cell phones in instruction thus transforming learning (Project Tomorrow, 2010a).

The second factor found was that a large proportion of the studies originated outside of the United States. This was not unexpected as over one billion people worldwide are cell phone users (C. Rosen, 2004). Friedman (2000) expressed that international education is working to

bring together capital, technology, and information for the purpose of creating a single global market.

Finally, the tools used for the majority of students were either provided to students by industry or by their school. Very few studies were found using the students' personal cell phone. This practice is commonly referred to as Bring Your Own Device (BYOD, Ullman, 2011). In a survey from Blackboard and Project Tomorrow, 60% of students in Grades 6 through 12 think using their own phones would improve technology at their school. In addition, 62% of parents said if schools required a mobile device for educational use that they would buy them for their child (Project Tomorrow, 2010b).

In 2003, the Wolverhampton (UK) City Council coordinated with Learning2Go to provide mobile learning for the students in their schools. The first phase of the program provided 120 mobile devices to four schools. Two years later in 2005, an additional 1,000 students and teachers in 18 schools received the devices. That number increased by 1,000 in the fall of 2006, and in 2008, another 1,500 units were distributed to students and teachers (Learning 2Go, 2011).

The mobile devices provided by the Learning2Go (2011) initiative were small, instant on, contained wireless connectivity, interacted with existing educational networks, had a built-in camera, high screen resolution, full day battery life, accepted external memory cards, and could browse and play flash and Multimedia content. The devices were also developed with Word, Excel, and PowerPoint capabilities. Lastly, each device was loaded with education applications developmentally appropriate for the age of the students. This device was designed specifically for this project (Learning2Go, 2011).

The first phase of the program was funded by the council. At the end of that first year parents were asked if they would be willing to contribute to the cost. Parents were pleased with the results of the mobile device and agreed to contribute. Any shortcoming was then funded by the individual schools (Learning2Go, 2011).

An outside agency was employed to evaluate the project. The evaluation was extensive and built upon after each phase of implementation. In interviews with the students the evaluators found, "There can be little doubt that the increased general ICT [information and communications technology] capability of the children involved in the project is its most conspicuous achievement" (Perry, 2003, p. 7).

Perry (2003) found that the expected outcomes were indeed realized in the initial phase of the project. Those outcomes included

1. Students took ownership in the device and became proficient in its use
2. All students with devices achieved high level KS2 national curriculum outcomes
3. Teachers' accuracy in assessments improved
4. Collaboration increased both in and out of school
5. Teacher efficiency and preparation and planning improved
6. Integration of home to school computer was evident
7. Learning through the devices added fun
8. Students lead innovations and released enthusiasm (Perry, 2003, p. 2)

Netsu (2006) embarked on a year-long action research project in a university English class. The purpose of his study was to have students use their personal cell phones for group discussions, essays, verbal communication in oral presentations, and imaging.

Over two semesters Netsu (2006) assigned eight student activities. The first activity involved the use of a cell phone buddy. Groups of four to five students partnered to send emails/texts to each other. If a student was absent, it was the responsibility of the *buddies* to take pictures of assignments and forward those to the missing student. Once students were comfortable with their groups, Netsu (2006) began sending them texts using key words. Students were to expound on those key words to better develop their English skills. The second activity was to set all students up with a Yahoo! Japan account in order for them to have access to the computer capabilities. Computer labs at the university were in short supply and high demand. The Yahoo! accounts allowed his students 24/7 access to a computer.

For the third activity the students were asked to complete a photo album. Some of the advanced students were able to complete this assignment with ease while others did not display the ability to finish the assignment. Netsu (2006) then asked the students to use their phones outside the classroom and take pictures to support their understanding of English. Informal, oral presentations were given over their products. The most creative assignment, so said the students, was the Library Treasure Hunt. Students were asked to create a treasure hunt in the university library that involved completing tasks and problem solving. Netsu (2006) was not completely satisfied with this activity so he led the students on a Teacher's Treasure Hunt that he created. Students created a cell phone picture PowerPoint. This activity required both the teacher and the students to expend intense effort. Both Netsu (2006) and the students remarked that the project was worthwhile. The final activity the students participated in was a cell phone detective hunt. In reviewing his action research, Netsu (2006) felt he accomplished his initial goals. He expressed looking forward to the advancement of the cell phone capabilities so that he can expand his research in the future.

In 2007, Milrad and Spikol conducted the MUSIS (Multicasting Services and Information in Sweden) study exploring the use of smart phones in university classrooms. Through the support of TeliaSonera and Bamboo Media Casting, volunteer student participants were loaned smart phones to use during the three-month trial period. Of the 41 volunteers, all already owned cell phones making the implementation of the tools seamless. The five participating instructors were also given smart phones to use.

In the first phase of the project educational materials were delivered to students through video-formatted *micro lectures*. A web interface was designed specifically for this project. In phase two of the project the students and instructors were to communicate and collaborate using the smart phones. Video, audio, and text messaging were used for this phase of the project. Each instructor had the freedom to design the format of the communication (Milrad & Spikol, 2007).

Data collection included surveys and interviews of the volunteer participants. In addition, a 90-minute workshop was held and videotaped at which time participants discussed their perception and future uses on the technology. The students perceived the smart phones as something they could integrate in daily life, dynamic, and potentially useful in their learning process. Participants were given a scale of *very useful*, *useful*, *fairly useful*, and *not useful* to complete. A survey at the end of five weeks found 49.5% regarded the smart phone useful in course-related information. That number dropped to 31% at the end of the 10-week mark of the experiment (Milrad & Spikol, 2007).

In the second phase of the study, where the primary use of the smart phone was communication, 52.4% of the students marked *high interest* and 19% of the instructors responded that they had *no interest.* In regards to the tool itself, the students reported they did

not take ownership of the loaned phone and would have felt more comfortable if they had the opportunity to use their own phone for the study (Milrad & Spikol, 2007).

During the 2007-2008 school year, three teachers responded to a Becta research grant to implement the use of cell phones in their secondary classrooms through the University of Nottingham (BBC News, 2007). These teachers demonstrated courage as England's Children's Minister, Kevin Brennon, had previously announced to parents to not allow their children to bring their Christmas toys, such as cell phones, to school. The secretary of the teacher's union agreed when he said, "Teachers would be grateful if pupils just brought a pen" (BBC News, 2007, para. 5).

Although sponsored by the university, the individual teachers set up the activities for this study. School A proposed students used their own phones 24/7 for nine months. School B had their students use their own SIM cards in "unlocked" 24/7 smart phones. School C chose to use provided unlocked smart phones for school-day use only (Hartwell-Youn & Heym, 2008). Since all schools had written policies against the use of cell phones during the school day the teachers had to be creative to maneuver around this ban. Data collection included observations, conversations, documents, samples of products, and surveys (Hartwell-Young & Heym, 2008).

There were 15 activities in which students used their cell phones to support their learning. The most popular activity included 96% of the participants using the still camera function. The camera was used to record results, create eportfolios, and photograph texts for future use. In addition, the phones were used as a stopwatch, receiving and sending texts and email, setting up calendars and timetables, recording teacher lecture, accessing the Internet, creating movies, downloading podcasts, as a GPS, transferring files between home and school, Bluetoothing, and logging into the school email system (Hartwell-Young & Heym, 2008).

Almost all students and teachers reported that they were more motivated and enjoyed the activities on the cell phone. The baseline survey showed that only 12% of students ever thought that phones could be used in learning. By the end of the study over 42% realized the learning capabilities of the phones. Teachers reported that students communicated better by texting than they did through face-to-face contact. Most students gained an appreciation of extending learning to home life after the study. School B did report that although the students were initially motivated their enthusiasm waned after about six weeks in the study. During the study one teacher phone and one student phone were stolen. Overall the participants felt the study was a success because new literacies were learned and new attitudes were developed (Hartwell-Young & Heym, 2008).

In 2008, Project K-Nect was developed by Digital Millennial Consulting, which is a cross-sector consulting firm that specializes in educational technology. Project K-Nect was funded by Qualcomm's Wireless Reach Initiative and in partnership with the North Carolina Department of Public Instruction (Digital Millennial Consulting and Qualcomm Incorporated, 2007). This one million dollar investment was created to increase student achievement in math as well as bridge the digital divide in low economic regions of North Carolina.

During the 2008-2009 school year, students enrolled in Algebra I from three Onslow County school districts were provided smart phones. Students were encouraged to use the phones both at school and at home. The features on the phones allowed students to instant message, take pictures and shoot video, use the calculator function, and provided 24/7 Internet access (Digital Millennial Consulting and Qualcomm Incorporated, 2007).

Throughout the project students used the smart phones to communicate with classmates and teachers, look up information on the Internet, receive alerts about homework and tests, and

work on group projects. Students reported they had a *teacher in their pocket* and the comfort of knowing help was available through the teacher or classmates kept them focused on their work. In the past the same students reported that when they were home and needed help they would just simply give up. Teachers shared that the use of the smart phones led to students taking greater responsibility for their own learning. The students became more collaborative, active, and engaged in class (Digital Millennial Consulting and Qualcomm Incorporated, 2007).

The results, released by Project K-Nect, offered a glimpse of how cell phone technology could change education for students. Of the students who participated, 85% felt more successful in math. Specifically 94% felt more comfortable learning math, 85% helping others with math, and 82% talking about math in general (Project Tomorrow, 2010a).

The data on the Algebra I End of Course Assessment showed an impressive 92% of students who participated in the K-Nect project demonstrated proficiency while the state average was 68%. Following the project student participants were allowed to keep the smart phones and almost two-thirds of the students enrolled in additional math courses (Project Tomorrow, 2010).

As a member of a panel discussion at the 2011 Florida Educational Technology Conference, Judy Copeland, was asked if she saw any unintended consequences from the project. She was quick to respond that she "recognized joy in the faces of the students when they were successful" (J. Copeland, personal communication, January 13, 2011).

Based on their years spent in higher education researching the topic of technology in the classroom, Soloway et al. (2001) teamed together to create GoKnow. Their for-profit company produced software applications that enable smart phones to become mobile learning environments (Soloway et al., 2001). GoKnow has partnered with Verizon to pilot their program in schools around the world.

During the 2008-2009 school year Trinity Meadows Intermediate School in Keller, Texas received complementary smart phones and free connectivity from Verizon, while GoKnow contributed the software package. There were 50 fifth-grade students who participated in the semester long trial. Mike Cook, the classroom teacher integrated the cell phone into *everything they did*, and Joe Griffen, the district technology coordinator, used data supplied by the vendor to plan for future content delivery (as cited in Schachter, 2009).

In the spring of 2008, St. Mary's City (Ohio) School District received the financial support from Samsung and Verizon along with software from GoKnow to implement a cell phone program in grades 3-6. Kyle Menchhofer, the district technology coordinator, said the school had fewer behavioral issues, the students were more engaged, and parents were willing to purchase the phones (Schachter, 2009).

In late 2009, 150 fifth grade students at Cimarron Elementary School in Katy, Texas, took part in the pilot program supported by HTC cell phone provider and Verizon. Their phones were equipped with GoKnow software. The program was such a success that the district is working with cell phone carriers to come up with an affordable data plan so that the program can grow throughout the district (Schachter, 2009).

In November of 2009, Sprint worked with Haverstraw Middle School in Garnerville, New York, to provide 80 students with Etech equipped smart phones. Students downloaded assignments, listened to and created podcasts, took quizzes and tests, and stored work in elocker (Schachter, 2009). John F. Kennedy School in Illinois provided all sixth-grade students with Nova5000 mobile devices for the 2009-2010 schoolyear. These cell phones came with software application for both science and math (Schachter, 2009).

Summary

There is strong historical evidence that the educational system is slow to embrace new technologies (Schrum & Levin, 2009). Researchers have isolated teacher attitude, accessibility, professional development, and school safety as the barriers to implementing new technologies in the classroom (Cuban, 1986; Harwood & Asal, 2007; Montgomery, 2009; Palfrey & Gasser, 2008). The review of literature demonstrated a clear picture of the new learner, the digital native, and the need to learn differently than students of past generations (Prensky, 2010).

The most recent studies of cell phone use in the classroom provide a glimpse of possibilities as to how the landscape of traditional teaching could significantly change. Optimism comes from recognizing antecedents of mobile learning that have paved the way for educational stakeholders to continue the journey ahead (Wagner, 2008).

CHAPTER 3

METHODOLOGY

From the two-finger *hunt and peck* method of typewriting to the two-thumb method of texting, students have quickly adapted their dexterity to new technologies. Schools, on the other hand, have been slow to incorporate advanced technology into the classroom. The evolution from the inkwell and pen to the typewriter to the computer keyboard has taken well over a century.

The opportunity now exists for every student to use a personal mobile device as a learning tool in the classroom. Yet, schools have banned the use of such devices within their boundaries. These policies did not emerge from thoughtful technology assessments, and mobile phones were not integrated into the school curriculum (Katz, n.d.).

Throughout history skepticism from educators has derailed the use of advanced technologies in the classroom, be that the use of a ball point pen or a cell phone. The resistance comes not from the technology itself, but from fear. First, there is the fear of the pedagogical consequences when educators relinquish control in the classroom (Katz, n.d.). Second, there is the fear that students will use the mobile device in an inappropriate manner; texting friends, cheating, and surfing nonacademic related material. Referring to cheating, Harwood and Asal (2007) contended that although the tools of the trade have changed, the behavior is old. Finally, educators fear that when personal mobile devices are expected to be used in the classroom there

will be a divide in digital equity. Research shows evidence that innovative schools are finding ways to provide devices to students who do not currently own them (Stansbury, 2011).

One area in which skeptics and proponents agree is that when students are engaged in learning their academic performance increases. E. A. Skinner and Belmont (1993) defined student engagement:

> Children who are engaged show sustained behavioral involvement in learning activities accompanied by a positive emotional tone. They select tasks at the border of their competencies, initiate action when given the opportunity, and exert intense effort and concentration in the implementation of learning tasks; they show generally positive emotions during ongoing action, including enthusiasm, optimism, curiosity, and interest. (p. 573)

Research indicates that students engage with tasks they find interesting, challenging, and important (Australian Government Department of Education, Employment and Workplace Relations, 2001). A poll of students in Australia found that a task is

- Interesting when it catches attention, when it presents something not completely predictable, or not fully known, something more to find out, to be explored or to discover,
- Challenging when there is a goal or end to work towards, to achieve, and reasonable confidence of being successful, and
- Important when it offers something, or leads to something of value. It may be something of immediate value; it may offer access to a more long-term goal and long-term satisfaction. (Australian Government, 2001, p. 2)

In a 2009 survey, 52% of middle and high school students indicated that in their *ultimate school*, mobile technology would have the greatest positive impact on learning (Project Tomorrow, 2010b). The purpose of this study was to determine the benefits to learning and teaching when cell phone technology is used as an instructional tool. Information was gathered to add to the body of educational research concerning tecnonology integration to aide in the serach for the ultimate school.

Research Questions

Research questions provide a framework to help the researcher organize the study in order to give it direction, coherence, and relevance (Onwuegbuzie & Leech, 2006). The following questions were constructed to organize this particular study.

1. Is there a significant difference between STEM teachers and teachers of other disciplines in the perceived importance of integrating technology in their instruction?
2. Is there significant difference between STEM teachers and teachers of other disciplines in their ability to design and assess lessons supported by technology?
3. Is there a significant relationship between teacher comfort level with technology use and their integration of technology to support their lessons?
4. Are levels of student engagement different based on the frequency of integration of technology?
5. Do the nine proficiency indicators serve as predictors of student engagement as reported by teachers?

Null Hypothesis

The study encompassed the following null hypotheses:

H_0 **1**. There is no significant difference between STEM teachers and teachers of other disciplines in the perceived importance of integrating technology in their instruction.

H_0 **2**. There is no significant difference between STEM teachers and teachers of other disciplines in their ability to design and assess lessons supported by technology.

H_0 **3**. There is no significant relationship between teacher comfort level with technology use and their integration of technology to support their lessons.

H_0 **4.** There is no significant difference in levels of student engagement based on the frequency of technology used in the classroom.

H_0 **5 .** The nine proficiency indicators do not serve as predictors of student engagement as reported by teachers.

Research Methodology

In order to test these hypotheses, I conducted a study to collect pertinent data. The study involved the use of an electronic survey distributed to 500 secondary teachers asking their current relationship, attitudes, and opinions with technology. The survey queried the following:

1. Teacher attitude toward using technology in the classroom.
2. Teacher competency with technology.
3. Teacher opinions on the use of technology.

In addition, teachers were asked to share their experiences for the integration of a specific technology, namely cell phones, in their classroom. If teachers had not yet integrated cell phones in their lessons they had the opportunity to share why they had chosen not to do so.

The recipients of the confidential survey were chosen using the stratified random sampling method. Only teachers employed in public high schools in Illinois, Indiana, Kentucky, Michigan, and Ohio were surveyed. Surveys were electronically distributed by means of a

database created by me. The random selection included the 14th teacher in the directory from every sixth school in each state. The distribution of schools was as follows based on the total number of public schools operating in each state and reflected in Table 5.

Table 5

States Selected for Random Teacher Selection

State	Percent of Teachers Surveyed
Ohio	28%
Illinois	26%
Michigan	24%
Indiana	12%
Kentucky	10%

Questions were garnered for the survey from a tool which was created for use with Norcross High School students and teachers in Norcross, Georgia. This tool was developed by Marlar et al., (2007) as an assignment for EDIT 6320, a graduate course at the University of Georgia. The assignment included using the standards of technology integration from the International Society for Technology in Education to create a comprehensive technology integration survey.

Data Analysis

The first null hypothesis states that there is no significant difference between STEM teachers and teachers of other disciplines in the perceived importance of integrating technology in their instruction. This was assessed through the use of a *t*-test to determine any statistical difference between the mean of STEM teachers and the mean of teachers of other disciplines. A

t-test was also used to look for any statistical difference in the mean of STEM teachers and the mean of teachers of other disciplines in their ability to design and assess lesson supported by technology as stated in null hypothesis two. The *t*-test was deemed appropriate for this analysis because I was looking for any differences between scores and, although scores may often look different, a statistical difference can only be rationalized by comparing the means of two scores. In both of these *t*-tests, the teacher groups—STEM, or teachers of other disciplines—was the independent variable. For Null Hypothesis 1 the dependent variable was a composite score of the nine items asking respondents to rate the importance of technology. In Hypothesis 2 the teacher groups served as the independent variable with the teacher query stating, *I classify my ability to design and assess lessons supported with technology resources for students as*

- Not yet
- Beginner w/support
- Confident on my own
- Capable of teaching others

The magnitude and direction of the association of teacher comfort level with technology use and their integration of technology to support lessons in Null Hypothesis 3 were deciphered through the use of a Pearson correlation. The Pearson correlation was chosen to investigate dependence between the two variables. Data were gathered from the survey question asking respondents how they classified themselves as technology users. Teachers marked *not yet*, *beginner with support*, *confident in my own abil*ity, or *capable of teaching others.* The correlation was made after the survey question asked teachers to rate their frequency using technology with their students. In this question respondents had five items to choose including *seldom or never*, *2-4 times a year*, *monthly*, *weekly*, or *daily*.

An analysis of variance was determined using a one-way ANOVA to answer Null Hypothesis 4: there is no significant difference in levels of student engagement based on the frequency of technology used in the classroom. Considering there was more than one group of independent variables, the ANOVA was chosen as the best fit for this analysis rather than doing several *t*-test. Respondents rated student engagement when using technology through three survey items, including (a) students create products that show higher level of learning, (b) students are more motivated, and (c) there is more collaboration.

The final null hypothesis—the nine proficiency indicators do not serve as predictors of student engagement as reported by teachers—were tested through the use of a multiple regression. A composite score of the three survey items included (a) students create products that show higher level of learning, (b) students are more motivated, and (c) there is more collaboration served as the criterion variable and the predictor variables were the nine technology proficiencies listed:

1. Learning how to use a new piece of software
2. Using the Internet for general searching
3. Acting as a guide for students when researching on the Internet
4. Troubleshooting problems that occur when using technology
5. Using software productivity tools (word processing, data base, spreadsheets, presentations tools, etc)
6. Integrating technology into daily lessons
7. Teaching and sharing with others how to use technology
8. Using technology in support of curriculum standards
9. Locating learning opportunities needed to advance my technology skills

The descriptive data collected in the survey that specifically addressed cell phone usage and respondent summaries describing teacher experiences with cell phones in their classroom are examined in Chapter 5 where I make the conceptual leap from general technology use to the newest 21st century technology tool, the cell phone.

CHAPTER 4

ANALYSIS OF DATA

The purpose of this study was to determine to what effect there are benefits to learning and teaching by using cell phone technology as an instructional tool. This included the perception of teachers and their relationship to technology in general. An analysis was prepared to determine what factors contributed to the perceptions of teachers, thus their use of technology in the classroom. Specific use of cell phones as an instructional tool was queried. Descriptive data collected from the respondents included gender, subject taught, confidence with technology, experience in the use of technology, the ability to design lessons using technology, the frequency technology was used in their classroom, and the percentage of students in their classrooms proficient with technology.

The design of the study included the following procedures:

1. During the fall of 2011, 500 public school teachers in the Midwest were selected through a stratified random sampling method to participate in the study.
2. The participants were selected through the use of the Indiana Department of Education, Michigan Department of Education, Ohio Department of Education, Kentucky Department of Education, and Illinois Department of Education lists of public schools. In each state database every 14th teacher in every sixth school was selected to participate. Each teacher's individual email address was collected from the schools' website.

3. I utilized Qualtrics Survey Software to electronically distribute the Teacher Technology Survey to the 500 selected participants. A cover letter explaining the purpose of the study, the participant's rights when completing the survey, and instructions for the survey accompanied the instrument (Appendix A). Teachers were asked to respond to questions on their general demographics, competency in technology use, opinions and attitudes toward using technology in the classroom, and the use of cell phones as an instructional tool. Participants also had the opportunity to write a summary of their experiences using a cell phone-integrated lesson or to articulate why they had never taken the opportunity to integrate cell phones in the classroom.
4. To obtain a high rate of return, I sent a follow-up cover letter two weeks after the initial survey was distributed (Appendix B). This letter gave more detail about the survey, asking respondents to complete it promptly if they had not already done so.

Teachers in public schools in Indiana, Illinois, Kentucky, Michigan, and Ohio that included Grades 6 through 12 were invited to participate in the study. Of the 500 teachers who received the invitation to participate, 130 participated.

This chapter provides a description of the data as well as presents the results of the study. The chapter is organized into the following sections: Descriptive Data, Findings and Analysis, and Summary.

Research Questions

Five major research questions guided this study. The emphasis was on the perceptions and attitudes of teachers in respect to using technology as instructional tools. A survey was created to respond to the research questions. The data collected contains 130 respondents who

participated in the survey (N = 130), representing 26% of all selected participants in the study. Those research questions are

1. Is there a significant difference between STEM teachers and teachers of other disciplines in the perceived importance of integrating technology in their instruction?
2. Is there significant difference between STEM teachers and teachers of other disciplines in their ability to design and assess lessons supported by technology?
3. Is there a significant relationship between teacher comfort level with technology use and their integration of technology to support their lessons?
4. Are levels of student engagement different based on the frequency of integration of technology?
5. Do the nine proficiency indicators serve as predictors of student engagement as reported by teachers?

Respondents by Gender

Of the 120 respondents who completed the survey 71 (59%) were women and 49 (41%) were men. These results are reflected in Table 6.

Table 6

Respondents by Gender

Gender	*N*	Percent
Women	71	59%
Men	49	41%
Total	120	100%

Respondents by Subject Taught

Respondents were queried on the subject they taught. They were instructed to mark all subjects that applied. This question found 121 (*N = 121)* respondents marked 165 subject areas; 44 (36.4%) marked more than one subject. There were 16 choices for the respondents to mark including art, business, computer lab, foreign language, health and/or physical education, history and/or social studies, industrial technology, language arts, mathematics, music, reading, science, special education, vocational education, and other. No respondents replied to the category of English as a Second Language. I acknowledged that the large range of choices expunged the sample size. Thus, for the purpose of valid results, the 16 choices were divided into two categories of subjects. The categories were chosen though research that surfaced in the literature review. A category was created from those teachers who were assigned STEM classes. All remaining subjects were placed in the *other* category. The results of this descriptive data are found in Table 7.

Table 7

Respondents by Subject Taught

Subject	*N*	Percent
STEM	70	42.42%
Other	95	57.58%
Total	165	100.00%

Respondents' Use of Technology

The respondents were asked to classify themselves as technology users. As shown in Table 8, respondents were given the options of *not yet*, *beginner w/support*, *confident on my own*, and *capable of teaching others*. No teachers responded that they had not yet begun to use technology. Of the 120 (*N = 120)* respondents, 17 (14.2%) reported that they were beginners with support. The majority of teachers, 63 (52.5%), responded that they were confident on their own with their use of technology. On being capable of teaching others, 40 (33.3%) teachers responded to this option.

Table 8

Respondents Self Classification of Technology use

Classification	*N*	Percent
Not yet	0	0.00%
Beginner w/support	17	14.17%
Confident on my own	63	52.50%
Capable of teaching others	40	33.33%
Total	120	100.00%

Respondents' Use of Technology with Students

Teachers responding to their experiences using technology with students are reported in Table 9. Teachers were given five options to document their number of years of experience using technology with their students.

Table 9

Respondents' use of Technology with Students

Classification	*N*	Percent
Not yet started	4	3.31%
1 year	7	5.78%
2 – 3 years	22	18.18%
4 – 5 years	12	9.92%
5+ years	76	62.81%
Total	121	100.00%

Respondents' Ability to Design and Access Lessons Using Technology

Of the teachers surveyed, (*N* = 120) responded to their ability to design and access lessons using technology. As reflected in Table 10 the respondents were given four choices in this category which included *not yet begun, beginner with support, confident on my own,* and *capable of teaching others*. One (0.08%) of the teachers reported that he or she *had not yet begun,* 31 (25.8%) teachers reported that they were *beginner with support,* 61 (50.8%) of the respondents marked that they were *confident on their own,* and 27 (22.5%) teachers reported that they were *capable of teachingothers* how to design and access lesson using technology.

Table 10

Respondents' Ability to Design and Access Lessons with Technology

Classification	*N*	Percent
Not yet	1	0.83%
Beginner w/support	31	25.83%
Confident on my own	61	50.83%
Capable of teaching others	27	22.51%
Total	120	100.00%

Respondents on Frequency of Technology Use with Students

Teachers were asked to rate their frequency of technology use with students. The respondents were given five choices including *seldom or never*, *2 – 4 times a year*, *monthly*, *weekly*, or *daily*. Of the 121 (*N* = 120) teachers who responded, five (4.1%) marked *seldom or never*, six (5.0%) of the teachers marked *2 – 4 times a year*, 14 (11.6%) of the respondents chose *monthl*y, 35 (28.9%) teachers marked *weekly*, and 61 (50.4%) teachers indicated they use technology *daily* with their students. The responses are charted in Table 11.

Table 11

Respondents on Frequency of Technology use with Students

Frequency	*N*	Percent
Seldom or never	5	4.13%
2 – 4 times a year	6	4.96%
Monthly	14	11.57%
Weekly	35	28.93%
Daily	61	50.41%
Total	121	100.00%

Respondent on the Percentage of Students Proficient with Technology

Teachers were asked to indicate their student's proficiency with the use of technology. Their choices included *not sure, less than 25%* proficient, *25 – 49%* proficient, *50 – 75%* proficient, or *76%+* proficient. Responses with their percentages are presented in Table 12.

Table 12

Respondents on Percentage of Students Proficient with Technology

Student Proficiency	*N*	Percent
Not sure	6	4.96%
Less than 25%	9	7.44%
25 – 49%	30	24.79
50 – 76%	35	28.93%
76+%	41	33.88%
Total	121	100.00%

Respondents' Proficiency on Specific Technology Use

Teachers were asked to rate their proficiency with specific technology use on a Likert scale. There were nine specific technology items on the scale that rated the respondent's proficiency from 1 to 5, with 1 indicating low skill level to 5 being high skill level. A total of (*N* = 130) public school teachers responded to these survey questions. Respondents rated *using the Internet for general searching* (*M* =4.67, *SD*= .47), *acting as a guide for students when researching on the Internet* (*M*= 4.25, *SD*= .91), and *using software productivity tools* (i.e., word processing, database, spreadsheets, presentations tools, etc) (*M* = 4.16, *SD* = 1.03) as their most proficient tools. The respondents rated *troubleshooting problems that occur when using technology* (*M* = 3.39, *SD* = 1.21) as their least proficient skill. Respondents were given the opportunity to mark *I prefer not to answer*. Table 13 illustrates the teacher's ratings on all nine specific technology skills.

Table 13

Respondents' Proficiency on Specific Technology use

Item	*N*	*M*	*SD*	Low Skill Level 1	2	3	4	High Skill Level 5	I prefer not to answer
Learning how to use a new piece of software	103	3.93	1.09	3	6	27	27	39	1
Using the Internet for general searching	100	4.67	0.74	2	0	4	17	77	0
Acting as a guide for students when researching on the Internet	102	4.25	0.82	2	2	13	38	46	1
Troubleshooting problems that occur when using technology	97	3.39	1.21	7	16	27	27	19	1
Using software productivity tools	103	4.16	1.03	1	8	16	28	49	1
Integrating technology into daily lessons	99	4.01	1.16	3	8	19	29	35	5
Teaching and sharing with others how to use technology	103	3.62	1.23	8	9	26	32	27	1
Using technology in support of curriculum standards	102	3.86	1.07	4	7	19	43	27	2
Locating learning opportunities needed to advance my technology skills	101	3.69	1.17	5	12	21	36	25	2

Respondents by Importance of Specific Technology

The same nine questions on Table 13 were asked again, requesting the responders to rate the importance of each of the items. A total of (N = 99) teachers responded to this section of the

survey. Teachers rated *using the Internet for general searching* (*M* = 4.54, *SD* = 0.88) and *acting as a guide for students whenresearching on the Internet* (*M* = 4.48, *SD* = 0.84) as most important. The same teachers rated *teaching and sharing with others how to use technology* (*M* = 4.07, *SD* = 1.10) and *integrating technology into daily lessons* (*M* = 4.13, *SD* = 0.99) as least important. As in Table 13 teachers were given the opportunity to mark *I prefer not to answer*.

Table 14

Respondents' Proficiency on Specific Technology Use

Item	*N*	*M*	*SD*	Low Skill Level 1	2	3	4	High Skill Level 5	I prefer not to answer
Learning how to use a new piece of software	99	4.29	0.91	2	1	14	32	49	1
Using the Internet for general searching	96	4.54	0.88	2	3	4	19	68	0
Acting as a guide for students when researching on the Internet	97	4.48	0.84	1	2	10	20	64	0
Troubleshooting problems that occur when using technology	94	4.27	0.91	2	2	11	33	46	0
Using software productivity tools	99	4.36	0.86	1	2	13	27	56	0
Integrating technology into daily lessons	95	4.13	0.99	2	3	18	32	38	2
Teaching and sharing with others how to use technology	99	4.07	1.10	3	6	18	28	42	2
Using technology in support of curriculum standards	99	4.24	0.95	2	3	13	33	47	1

Table 14 (continued)

Item	*N*	*M*	*SD*	Low Skill Level 1	2	3	4	High Skill Level 5	I prefer not to answer
Locating learning opportunities needed to advance my technology skills	99	4.21	0.93	3	1	13	37	45	0

Table 14 reflects responses of all teachers who completed this section of the survey.

Respondents' Opinions and Attitudes Toward Technology

In the third section of the survey teachers were asked attitudinal questions pertaining to different technologies, their role in education, and the future of these different technologies. Teachers were asked to mark their attitudes as *strongly agree*, *agree*, *disagree*, or *strongly disagree* on five questions each beginning with "When students use technology." There were 101 teachers who completed this section of the survey as detailed in Table 15. Of the respondents, 70.7% *disagree*d or *strongly disagree*d that there are more discipline problems with using technology. In addition, 82.7% *agreed* or *strongly agreed* that students are more motivated when technology is used.

Table 15

Respondents' Attitudes Toward Technology

When using technology	*N*	*M*	*SD*	Strongly Agree	Agree	Disagree	Strongly Disagree
Students create products that show higher levels of learning	101	1.96	0.66	22	63	14	2
There are more discipline problems	99	2.86	0.74	3	26	52	18
Students are more motivated	98	1.96	0.69	23	58	15	2
There is more collaboration	100	2.21	0.66	11	59	28	2
Students do inappropriate things	100	2.58	0.68	4	41	48	7

The last part of this section asked teachers to respond to 10 statements beginning with "I believe." They were given four choices to mark their opinion on each statement including *strongly agree, agree, disagree,* or *strongly disagree.* There were 102 teachers who responded to this section of the survey. Of the respondents, 88.12% *agree*d or *strongly agree*d that *technology has changed the way they teach*. In addition, 86.27% *agree*d or *strongly agree*d that *technology is a good tool for collaboration with other teachers when building unit plans*. In reference to the statement *most technology would do little to improve my ability to teach,* 77.23% of the teachers *disagreed* or *strongly disagreed*. The information in Table 16 documents teacher responses.

Table 16

Respondents' Opinions Toward Technology

I believe…	*N*	*M*	*SD*	Strongly Agree	Agree	Disagree	Strongly Disagree
Electronic media will replace printed text within five years	101	2.22	0.82	22	38	38	3
Most technology would do little to improve my ability to teach	101	2.90	0.69	3	20	62	16
Technology has changed the way I teach	101	1.85	0.61	27	62	12	0
Students are more knowledgeable than I am when it comes to technology	102	2.39	0.85	17	35	43	7
School systems expect us to learn new technologies without formal training	102	2.12	0.77	23	46	31	2
There is too much technological change coming too fast without enough support for teachers	102	2.08	0.75	25	44	33	0
Technology has left many teachers behind	101	2.01	0.62	19	62	20	0
Technology is a great tool for collaboration with other teachers when building unit plans	102	1.99	0.54	15	73	14	0
Technology is unreliable	100	2.58	0.70	7	33	55	5
Bring your own technology will be a standard practice in schools within the next five years	98	2.27	0.74	13	50	31	4

Hypotheses Tested

This study encompassed the following null hypothesis:

H_0 **1**. There is no significant difference between STEM teachers and teachers of other disciplines in the perceived importance of integrating technology in their instruction.

H_0 **2**. There is no significant difference between STEM teachers and teachers of other disciplines in their ability to design and assess lessons supported by technology.

H_0 **3**. There is no significant relationship between teacher comfort level with technology use and their integration of technology to support their lessons.

H_0 **4.** There is no significant difference in levels of student engagement based on the frequency of technology used in the classroom.

H_0 **5 .** The nine proficiency indicators do not serve as predictors of student engagement as reported by teachers.

Findings

Inferential testing was completed in order to test each of the five null hypotheses. Null hypothesis one stated, "There is no significant difference between STEM teachers and teachers of other disciplines in the perceived importance of integrating technology in their instruction." There was no violation of the assumption of independence as the sample observations were independent of each other. While initially a *t*-test was to be used to determine this null hypothesis, a violation of the assumption of normality, as charted in Table 17, was found and the use of the *t*-test was deemed inappropriate.

Table 17

Descriptive Statistics Importance of Integrating Technology-Skewness/Kurtosis

	N	*M*	*SD*	Skewness	Kurtosis
Importance Composite	99	4.2211	.72782	-1.493	3.307

The assumption of normality was violated based on the skewness and kurtosis of the dependent variable, *importance-composite*, being outside the range of +/- 1. After this violation was found, an additional test for normality was run using the Kolmogorov-Smirnov test on the importance-composite data. This is illustrated in Table 18.

Table 18

Descriptive Statistics Importance of Integrating Technology

	Kolmogorov-Smirnov		
	Statistics	*df*	Sig.
Importance–composite	.142	99	.000

The Kolmogorov-Smirnov test indicated a significance as the Sig. value was <.001 which confirmed a violation of the assumption of normality. As shown in Table 19, a homogeneity of variance test was completed with the results indicating nonsignificant Levene's test based on a significant value of .552.

Table 19

Descriptive Statistics Importance of Integrating Technology–Levene's

	Levene's Test for Equality of Variances	
	F	Sig.
Importance–Composite Equal Variances Assumed	.356	.552

The Mann-Whitney *U* test, as documented in Tables 20 and 21, was conducted to evaluate the null hypothesis that "There is no difference between STEM teachers and teachers of other disciplines in their perceived importance of technology." The results indicated there was no significant difference, $z = -.935$, $p = <.05$. STEM teachers had an average rank of 48.28, non-STEM teachers had an average rank of 51.72. This null failed to be rejected.

Table 20

Descriptive Statistics Importance of Integrating Technology-Ranks

Subject Area	*N*	Mean Rank
Non-STEM	58	51.72
STEM	40	48.28
Total	98	

Table 21

Descriptive Statistics Importance of Integrating Technology-Mann Whitney U

	Importance–Composite
Mann-Whitney *U*	1031.000
Z	-.935
Asymp. Sig. (2-tailed)	.350

Note. Grouping Variable: Area taught

Null Hypothesis 2, "Is there significant difference between STEM teachers and teachers of other disciplines in their ability to design and assess lesson supported by technology?" was examined through the use of a *t*-test. The survey item asking respondents to rate their proficiency in their *ability to design and assess lessons using technology* was the dependent variable in the *t*-test, and the area taught was the independent variable. The variables were independent of one another as no dependent variable scores were repeated, thus there was no violation of the assumption of independence. There was no violation of the assumption of normality as illustrated in Table 22 the skewness or kurtosis both fell within the appropriate range of +/- 1. The assumption of homogeneity of variance was not violated as there was a non-significant Levene's test as noted in Table 23.

Table 22

Ability to Design and Assess Lessons w/Technology – Skewness/Kurtosis

	N	*M*	*SD*	Skewness	Kurtosis
Ability to design/assess lessons w/ Technology	120	2.9500	.7200	-.062	-.693

Table 23

Ability to Design and Assess Lessons w/Technology–Levene's

	Levene's Test for Equality of Variances	
	F	Sig.
Ability to Design and Assess Lesson w/Technology	.933	.338

Once determined that the assumptions had not been violated an independent-samples *t*-test was conducted to compare the *ability to design and assess lessons with technology* in STEM teachers and non-STEM teachers. Table 24 indicates there was a significant difference in scores for STEM teachers ($M = 3.18$, $SD = .738$) and non-STEM teachers ($M = 2.80$, $SD = .872$), $t(119) = -2.78$, $p = .008$. These results suggested that STEM teachers rated themselves with a higher skill level in their *ability to design and assess lesson using technology* than do non-STEM teachers. This null hypothesis was rejected.

Table 24

Ability to Design and Assess Lessons w/Technology-Independent Samples T-Test

	T-test for Equality of Means		
	t	*df*	Sig.*
Equal Variances Assumed	-2.78	119	.008

Note. * $p < .05$, two-tailed

A Pearson *R* correlation was conducted to determine the relationship between teacher comfort level with technology and the frequency teachers integrate technology into their lessons. Null Hypothesis 3, "There is no significant relationship between teacher comfort level with

technology use and their integration of technology to support their lessons," suggested that no significant difference was present. An analysis of two questions relating to teacher comfort level in designing and assessing lessons using technology and the frequency of integration of technology was used in this correlation. Respondents were asked to rate their *ability to design and assess lessons using technology* on a 1–4 scale. Teachers who marked 1 had not yet begun to design and assess lessons using technology, whereas teachers who marked 4 reported they were capable of teaching others. The same scale was used when teachers classified themselves as technology users. Once again teachers who marked 1 indicated they had not yet begun using technology in their classroom. Those teachers who marked 4 felt capable of teaching others how to integrate technology in the classroom.

In order to acknowledge the appropriate use of the Pearson *R,* I checked all assumptions for normal distribution. The assumption of homoscedasticity did not appear to be violated as the scatterplot showed no systematic pattern. The assumption of linear relationship was not violated as there was a positive slope which was linear in nature. The data within these two variables were distributed in a broadly symmetrical way along the scale. Normality was checked and both the skewness and kurtosis was found to be in the acceptable range of +/- 1.

There was a significant positive correlation (r = .742, n = 119, p< .001) on scores of *teacher ability to design and assess lessons* and the *level of technology use of the teacher*. This correlation (r = .742) was considered a strong relationship. Specifically, as the level of technology use increased, their ability to design and assess lessons using technology increased significantly. Table 25 reflects this correlation.

Table 25

Correlation Between Teacher Comfort Level and Ability to Design and Assess Lessons

	Level of Technology User	Ability to Design and Assess Lessons
Level of Technology User	--	.742*
Ability to Design and Assess Lessons	.742*	--

Note. * $p \leq .01$. All tests were two-tailed

A one-way ANOVA was conducted to compare the levels of student engagement and the frequency of technology used in the classroom. The dependent variable for this test was student engagement while the independent variable was the frequency of technology use as reported by teachers. The question asked by the researcher *are levels of student engagement different basedon the frequency of integration of technology* was answered through this ANOVA.

The assumption of normality was violated through the kurtosis being outside the normal range of +-1 at 1.459. However, with all other assumptions being normal using the ANOVA was determined to be an appropriate test for this data set. An ANOVA can tolerate the violation of kurtosis as it is considered a robust test (Conover & Inman, 1981). As illustrated in Table 26 there was no significant difference in levels of student engagement based on the frequency of technology used in the classroom. Thus, the null was not rejected.

Table 26

Student Engagement Based on Frequency

	Sum of Squares	*df*	Mean Square	*F*	Sig.
Between Groups	.847	4	.212	.792	.533
Within Groups	25.930	97	.267		
Total	26.777	101			

The final null hypothesis suggested that the nine proficiency indicators do not serve as predictors of student engagement as reported by teachers. I determined that a multiple regression would be the most effective method to discern the relationship between the nine individual predictor variables and the criterion variable of student engagement. I first examined the assumptions of multiple regressions. The assumption of independence was not violated as the errors associated with one observation were not correlated with the errors of other observations. There was no evidence of an assumption of normality as the errors shown in the residuals plot of standardized residuals versus predicted values were evenly spread and rectangular in nature. The assumption of linearity was not violated as the relationship between the predictors and the outcome variable was linear when examining the plots of standardized residuals versus predicted values. In examining the assumption of homoscedisticity the error variance was constant as evident with no widening of the scatterplot when examining the residuals plots of standardized residuals versus predicted values. The width of the small predicted values of the dependent variable was very similar to large predicted values of the dependent variable. Finally, there was no evidence of multicollinearity as tolerance for each of the predictors was above the recommended .20 value.

Analysis shows the multiple correlation coefficient between the observed and predicted values of the criterion reported a moderate multiple correlation coefficient of .499. The coefficient of multiple determination (R^2) value was reported as .249, 24.9% of the variance in student engagement was explained by the technology proficiency of the teacher. The adjusted R^2 was used to correct R^2 based on the number of predictors as related to the number of subjects. In this study R^2 was reported as .249 while adjusted R^2 .164. The difference between the two, .085, was considered the shrinkage. Based on the standard error of the estimate (.481), which was the amount of variability in the data points around the regression line, this study had a standard deviation of .481. It was revealed through the multiple regressions that the predictor (technology proficiencies of teachers) did indeed have the ability to predict student engagement. The null failed to be rejected.

As shown in Table 27 the ANOVA was significant, F (9,79) = 2.916, p = .005, showing a relationship between teacher technology proficiency and student engagement. I rejected this null hypothesis.

Table 27

ANOVA Model Statistics for Criterion Variable for Student Engagement

F Value	Significance Value
2.92	.005

Table 28

Unstandardized and Standardized Partial Regression Coefficients for Student Engagement

Independent Variables – Proficiency	B	*SE*	β	*t*	*Sig.*
Learning how to use a new piece of software	-.098	.096	-.187	-1.021	.310
Using the Internet for general searching	.214	.121	.204	1.763	.082
Acting as a guide for students when researching on the Internet	.001	.107	.002	.013	.990
Troubleshooting problems that occur when using technology	.215	.080	.475	2.688	.009
Using software productivity tools	-.175	.080	-.302	-2.198	.031
Integrating technology into daily lessons	-.050	.070	-.102	-.718	.475
Teaching and sharing with others how to use technology	-.068	.083	-.140	-.815	.417
Using technology in support of curriculum standards	.134	.112	.249	1.201	.233
Locating learning opportunities needed to advance my technology skills	-.232	.078	-.506	-2.973	.004

Looking at each of the predictors individually, in Table 28, through a stepwise regression, the model indicated three predictors (technology proficiencies) that significantly predicted student engagement: *troubleshooting problems that occur when using technology, using software productivity tools,* and *locating learning opportunities needed to advance my technology skills. Troubleshooting problems that occur when using technology* was a significant predictor of student engagement, t (9,79) = 2.688, p = .009. *Using software productivity tools* was a significant predictor of student engagement, t (9,79) = -2.198, p = .031. Also a significant

predictor of student engagement was *locating learning opportunities needed to advance my technology skills* t (7.79) = -2.973, p = .004.

Troubleshooting problems that occur when using technology had a partial regression coefficient (β) of .215. This told that when holding all other variables constant, the teacher increases the ability to troubleshoot by one unit, student engagement was predicted to increase by .215. *Using software productivity tools* had a partial regression coefficient (β) of -.175 which meant when holding all other variables constant, when the teacher increased the ability to use software productivity tools by one unit, student engagement decreased by .175. *Locating learning opportunities needed to advance technology skills* had a partial regression coefficient (B) of -.232. When holding all other variables constant, this meant that when a teacher increased the ability to locate learning opportunities needed to advance technology by one unit, student engagement decreased by .232

For each predictor a standardized partial regression coefficient (β) was produced. The purpose of β was to measure the impact of each predictor on student engagement in standardized units of *z* scores. *Troubleshooting problems that occur when using technology* had a standardized partial regression coefficient (β) of .475. *Using software productivity tools* had a standardized partial regression coefficient (β) of -.302. *Locating learning opportunities needed to advance my technology skills* had a standardized partial regression coefficient (β) of -.506. The β showed the impact each predictor had on student engagement. *Locating learning opportunities needed to advance my technology skills* had the largest impact predicting student engagement even though it was a negative predictor. I rejected this null hypothesis.

Summary

Included in this chapter was an analysis of the data collected in the quantitative study to investigate the five research questions. Teachers were queried through an electronic survey which provided the data for the study. Research Question 1 asked if there is a significant difference between STEM teachers and teachers of other disciplines in the perceived importance of integrating technology in their instruction. Through the use of a non-parametric Mann-Whitney *U* test, it was determined that there was no significant difference between STEM and non-STEM teachers as they reported the importance of integrating technology in instruction. However, a significant difference was found in Research Question 2 which asked if there is a significant difference between STEM teachers and teachers of other disciplines in their ability to assess and design lessons supported by technology. This information was assessed through the use of a *t*-test. The results indicated that STEM teachers ($M = 3.18$, $SD = .738$) rated themselves higher in the ability to design and assess lessons supported by technology than did non-STEM teachers ($M = 2.80$, $SD = .872$).

A Pearson *R* correlation was conducted to determine if there was a relationship between the comfort level of teachers using technology and their integration of technology to support lessons, as asked by Research Question 3. A significant strong, positive correlation (.742) was found. This indicated that the more comfortable a teacher was with technology use the more willing the teacher was to integrate technology into lessons.

Student engagement in relationship to technology was investigated in Research Questions 4 and 5. A one-way ANOVA was conducted to answer Research Question 4 "Are levels of student engagement different based on the frequency of integration of technology?" The ANOVA found there to be no significant relationship, $F(9, 79) = 2.916$, $p = .005$, between

student engagement and the frequency of technology integrated in lessons. However, in regards to student engagement there was a significant impact of technology proficiency on student engagement discovered through the use of a multiple regression to answer Research Question 5. The nine proficiency indicators served as predictors of student engagement as reported by teacher participants. Of the nine predictors, three were found to significantly impact student engagement. *Troubleshooting problems that occur when using technology* was a significant predictor of student engagement, t (9,79) = 2.688, p = .009. *Using software productivity tools* was a significant predictor of student engagement, t (9,79) = -2.198, p = .031. *Locating learning opportunities needed to advance my technology skills* t (7.79) = -2.973, p = .004 was also found to be significant.

A summary and discussion of the results is presented in Chapter 5. Chapter 5 includes conclusions on the significant and non-significant results found, additional discussion on the descriptive data specifically related to cell phone use, and recommendations for the future use of this information.

CHAPTER 5

CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS FOR FUTURE RESEARCH

This chapter includes the conclusions drawn based on the results of the study, a discussion of findings from the analysis of data collected, and the implications this study has on current and future education. Participant responses were compiled from the survey and analyzed.

Purpose of the Study

In order for schools to prepare students with 21st century skills, to be successful in both existing and future jobs, technology must be integrated into the learning process. Research indicates that educators, both administrators and teachers, have been slow to embrace technology for a variety of reasons. Those reasons include cost, access, classroom management, authority, assessment, challenges to instruction, and what technology cannot teach (A. Collins & Halvorson, 2009). The purpose of this study was to determine to what effect there are benefits to learning and teaching by using cell phones, the most ubiquitous and current personal technology, as an instructional tool.

The research exposed numerous barriers for teachers to implement the use of cell phones in their classrooms. Cell phones are found in every aspect of daily living, yet schools, due to culture, fear, and ignorance, have stood firm with rules prohibiting their existence in the learning environment. Thus, teachers have had little opportunity to explore the use of the most common

technology in the classroom. This lack of tolerance for cell phones in schools posed an impediment to the researcher to carry out this study. However, despite limits on cell phone use in the classroom, five questions were developed based on general technology use and in this chapter will make the conceptual leap as to what effect cell phones can have when integrated in instruction.

The questions investigated were

1. Is there a significant difference between STEM teachers and teachers of other disciplines in the perceived importance of integrating technology in their instruction?
2. Is there significant difference between STEM teachers and teachers of other disciplines in their ability to design and assess lessons supported by technology?
3. Is there a significant relationship between teacher comfort level with technology use and their integration of technology to support their lessons?
4. Are levels of student engagement different based on the frequency of integration of technology?
5. Do the nine proficiency indicators serve as predictors of student engagement as reported by teachers?

The research affirmed that teachers are slow to adapt to the use of technology. The elements of teacher comfort level with the use of technology, the ability to design and access lessons using technology, and student engagement when technology is integrated, as queried in the research questions, provides insight as to the reasons for this traditionally slow process of implementation.

All entities of public high schools will benefit from this study. Administrators will see the importance of the hiring process and securing teachers who place importance on the use of

technology in their classrooms. Teachers, when seeing the relationship between technology and student engagement, will search for strategies to implement technology use in their lessons. Students will benefit most as their administrators and teachers understand the relevance of implementing current technologies into their curricula.

Discussion of Findings

The first research questions asked if there is a significant difference between STEM teachers and teachers of other disciplines in the perceived importance of integrating technology in their instruction. As discussed in Chapter 4, STEM teachers were separated from teachers of other disciplines based on research showing that STEM teachers were the first teachers to embrace technology in the classroom. A Mann-Whitney *U* test was used to prove the null hypothesis that there was no significant difference. A composite of the rating of two survey items was used to determine the outcome. Those items asked the teachers to rate the importance of (a) integrating technology into daily lessons and (b) using technology in support of curriculum standards. The items were rated 1 to 5 with 1 being of least importance and 5 being of high importance. What I deemed from this finding is that although STEM teachers first embraced the use of technology in the classroom, teachers of other disciplines have come along to accept that technology is important in the learning process. What is important in this study is that although there is no significant difference placed on the importance of technology based upon the discipline of the teachers, the study found that all teachers feel technology is important (M = 4.19, SD = .97).

The second research question asked the same grouping of teachers, STEM versus teachers of other disciplines, to classify their ability to design and assess lessons supported with technology resources. A significant difference was found through a *t*-test that showed that

STEM teachers rated themselves at a higher skill levels than teachers of other disciplines in their ability to design and assess lessons support with technology. This result can be explained that because, as research shows, STEM teachers adopted the use of technology sooner than teachers of other disciplines; they have been using technology longer and have more confidence in their ability to design strategies and assess lessons.

The relationship of teacher comfort level with technology as compared to their use of technology was explored in Research Question 3. A Pearson *R* correlation was conducted for the purpose of this question. Teachers were asked to classify themselves as technology users on a 1 to 4 scale. Teachers who had not yet begun to use technology marked themselves as a 1 and teachers who were comfortable teaching others marked themselves with the high of 4. The ability to design and assess lessons using technology ranking used in Research Question 2 was also used in order to determine teacher comfort level for this question. Once again teachers rated themselves with a 1 if they had not yet begun through a 4 if they were capable of teaching others. A very strong, positive correlation ($r = .742$, $n = 119$, $p < .001$) was found. What this indicated to me was that the more confident the teachers were in their own ability to use technology, the more comfortable the teachers were with their ability to design and assess lessons. Research showed that in order to gain confidence in using technology, "teachers must have ongoing exposure to technology in order for it to become a seamless component of their instruction" (CEO Forum, 1999, p. 8). Conversely, of the teachers who rated themselves as beginners with support in their technology use, 54.8% said they were confident enough to design and assess lessons using technology. In order for technology to be fully integrated in instruction teachers must become *fearless in their use of technology* (Illinois State Board of Education, 2002). Teacher competency is key in creating academically sound learning environments saturated with

technology. However, in this study, teachers self reported that they lack the knowledge, skills, and abilities to use these tools in ways to advance learning (Milken Exchange on Educational Technology, 1999).

Both Research Questions 4 and 5 explored student engagement with the use of technology. It is documented that engaged students are more likely to perform well academically (Akey, 2006; Garcia-Reid, Reid, & Peterson, 2005; Heller, Calderon, & Medrich, 2003). If student engagement could be tied to the use of technology then a case can be made that technology integration could increase student achievement.

A one-way ANOVA was used to compare the levels of student engagement with the frequency that technology is used in the classroom. The null hypothesis suggested that there would be no difference. A composite of three survey items asked of teachers when using technology provided the data for student engagement. Teachers were asked to mark whether they *strongly agree*, *agree*, *disagree*, or *strongly disagree* with the three items. The student engagement composite included *students create products that show higher levels of learning*, *students are more motivated*, and *there is more collaboration*. The literature review drew the connection between student achievement, motivation, and collaboration all in the context of student engagement.

The ANOVA conducted to answer the question, "Are levels of student engagement different based on the frequency of integration of technology?" proved that there was a significant difference. Teachers agreed that students show higher levels of learning, are more motivated, and are more collaborative when technology is integrated in their lessons. These same teachers used technology on a weekly basis with 50.4% of them integrating technology in their classroom on a daily basis.

Exploring student engagement at a deeper level was the question, "Do the nine proficiency indicators serve as predictors of student engagement as reported by teachers?" In order to make this determination a multiple regression was conducted. The predictor variable was teacher proficiencies while the criterion variable was student engagement. Teachers were asked to rate their proficiency on nine different skills in using technology. Teachers were presented with a Likert rating scale of 1 to 5 with 1 being the lowest skill level and 5 being the highest. In addition teachers were given the option to mark that they preferred not to answer. Of the nine proficiencies three were significant predictors of student engagement.

Teachers reported themselves least skilled in the area of troubleshooting problems that occurred when using technology. However, this item proved to be the most significant positive predictor of student engagement among the nine proficiencies. Unfortunately, glitches in technology occur more frequently than teachers would like. These setbacks, while frustrating, can actually generate growth (Vedova, 2011). When technology fails the class can experience lost time, frustration, and confusion. Through the process, though, problem-solving and collaboration flourish. Although trouble shooting problems is the antagonist for many teachers when using technology in the classroom, those who increase their ability to troubleshoot by one unit saw an increase in student engagement of (β) .215. With the potential to increase student engagement by over 20%, teachers would benefit from learning how to troubleshoot their own technology problems.

There were two proficiencies that were found to be significant, yet negative predictors of student engagement. The first was using software productivity tools such as word processing, databases, spreadsheets, and presentation tools. With a partial regression coefficient (β) of -.175 for every unit the teacher increased their proficiency in using software productivity tools,

student engagement decreased by 17.5%. This can be explained as software tools are basic to computer use. Word processing and spreadsheets are the skills new computer users first learn. Although these skills help the user navigate the computer they do nothing to enhance learning. Simply knowing how to use basic computer and software skills is not supporting learning through the integration of technology. In order to infuse technology in instruction teachers need to think and plan carefully and move beyond the *add on* approach of using PowerPoint and Word as ends in themselves (Jacobsen, Clifford, & Friesen, 2001). The digital generation has grown up with computers and these basic skills. Increased engagement comes from new experiences with technology that teachers have the ability to lead their students to and through (Wilson & Peterson, 1995).

The second significant, negative predictor was *locating learning opportunities needed to advance my technology skills*. Once again, this is a basic skill. Teachers who lack confidence in their technology ability certainly need to know how to advance their skills; yet, this does nothing to increase the engagement of the students in their charge. It cannot be expected that students would benefit from technology when their teachers are neither comfortable nor familiar with it.

> When new technologies are adopted, learning how to use the technology may take precedence over learning through the technology. The technology learning curve tends to eclipse contend learning temporarily; both kids and teachers seem to orient to technology until they become comfortable. Effective content integration takes times, and new technologies may have glitches. As a result, teachers' first technology projects generate excitement but often little content learning. Often it takes a few years until teachers can use technology effectively in core subject areas. (Goldman, Cole, & Syre, 1999, para. 5)

The five research questions were based on general technology use. Through this study I was most directly interested in the use of cell phones as an instructional tool in the classroom. I chose to make a conceptual leap from general technology to cell phone technology. Cell phones are one of many technology tools that can be integrated into instruction. When students select technology tools to help them obtain information in a timely manner, synthesize and analyze the information, and present it professionally, effective technology integration is achieved (U.S. Department of Education, 2006). The specific information gathered in the following descriptive data provides this study with depth on the subject of cell phones. While the most insightful information comes from the text responses recorded by 39 of the survey respondents when asked to share a summary of their experiences using cell phones in the classroom. This specific technology tool will be explored in the reminder of the chapter.

Respondents on Experience Integrating Cell Phones in the Classroom

In the fourth section of the survey, teachers were asked to participate only if they had previous experience with using cell phones in the classroom as an instructional tool. Of the 130 teachers who participated the survey, 37 responded to this section. Teachers were given 15 pairs of bipolar adjectives in this semantic differential rating scale. They were asked to consider each word pair and then rate their experience using cell phones in the classroom based on that particular pair of words. The right side of the scale indicated words that would make the experience positive and the words on the left of the scale indicated a negative experience. From right to left respondents could mark *very much, somewhat, neither*, *somewhat* or *very much.* Teachers found *engaged, creative,* and *effective* to be the top three most positive adjectives to describe their experience. Of the teachers who responded, 61.11% found integrating cell phone lessons as *engaged* as compared to 11.11% who found the lessons *disengaged*. There were

57.58% of teachers who found the lessons *creative* in contrast to the 12.12% who found the lessons *uninspired*. In response to the effectiveness of the integration of cell phones 54.29% found them to be somewhat or very much *effective* while 11.43% found the lessons *ineffective*. Table 29 outlines the responses of each of the teachers. In order to interpret the mean and standard deviation, Qualtrics assigned a 1 to the left side very much through a 5 to the right side very much.

Table 29

Respondents' Use of Cell Phones in Classroom

Word Pair	*N*	*M*	*SD*	Very Much	Some-What	Neither	Some-What	Very Much
Fun: Boring	37	2.41	1.07	9	10	13	4	1
Easy:Hard	37	2.81	1.13	4	12	11	7	3
Good:Bad	37	2.41	1.07	8	12	0	13	2
Exciting:Calm	35	2.49	0.95	6	10	16	2	1
Relevant:Irrelevant	35	2.51	1012	8	8	14	3	2
Beneficial:Unhelpful	36	2.39	1.05	8	11	14	1	2
Engaged:Unengaged	36	2.22	1.07	11	11	10	3	1
Empowered:Confined	36	2.33	0.96	9	8	18	0	1
Effective:Ineffective	35	2.46	1.04	6	13	12	2	2
Collaborative:Separate	33	2.58	1.17	8	7	10	7	1
Confident:Unsure	33	2.45	0.97	5	13	11	3	1
Thinking:Doing	33	2.97	1.16	5	4	14	7	3
Authentic:Fake	33	2.67	0.96	5	6	18	3	1

Table 29 continued

Word Pair	*N*	*M*	*SD*	Very Much	Some-What	Neither	Some-What	Very Much
Supported:Unfounded	33	2.67	0.82	3	9	17	4	0
Creative:Uninspired	33	2.30	1.07	9	10	10	3	1

This study found that 28.5% of secondary teachers in the Midwest have used cell phones in their classroom. This is in comparison to a 2010 national survey that found that 17% of high school teachers reported that their students used their cell phones for instructional purposes (Grunwald & Lippincott, 2011). This percentage pales in relationship to the 75% of high school students who own their own phones. In all of the 11 surveyed word pairs associated with the use of cell phones, teachers found the experience to be a positive. Key players in fostering student engagement are teachers (Akey, 2006; Garcia-Reid et al., 2005). Each of the word pairs that teachers found to be positive can be backed with research leading to student engagement.

C. N. Quinn (2005) argued that engagement does not have to help and as long as it does not hurt, it is positive. C. N. Quinn (2005) said the "learning can, and should, be hard fun"(p. 11). In a presentation at the 2011 Authorspeak conference, Rodgers asked his audience to consider bringing the cells phones that students use withexcitement every day outside of school into the school (Rodgers, 2011). Providing *relevant* education programming for all students promotes high levels of student engagement (Jones, 2009). Many styles of learners *benefit* from the use of technology (McDaniel, 2012). "Raised amidst pervasive, multi-gigabit wireless networks, the high school class of 2030 will be a truly digital generation, more *empowered*—and more challenged—than any who have come before" (Murray, 2008, p. 39). As teachers continue

to see the *benefits* of using mobile technology in the classroom, they create *effective* lessons that *engage* students (Jacobs, 2011). Challenging students through the use of global *collaboration* adds *authentic* practice and motivation to the classroom (November, 2010). Students with high levels of *confidence* are more likely to *engage* in school (Alvermann, 2003). The *engaged* classroom uses quality questioning as the catalyst for student *thinking* and learning (Walsh & Sattes, 2011). Students are *engaged* when they feel their lessons are *supported* through positive emotional involvement (Chapman, 2003).

In the final section of the Teacher Technology Survey respondents were asked to share a summary of their experience with cell phone use in the classroom. Respondents who had not yet integrated cell phones into the classroom were presented the opportunity to express to the researcher why. Some respondents provided detailed explanations of their experiences. One reported that "I have used cell phones as Student Response systems for a quiz. The students enjoyed the experience." Another teacher described her experience in entirety:

> Students were put in pairs, ensuring at least one had a cell phone, then each group sent me a text so I could program their "team name" into my phone. We then played a question and answer trivia game on a Shakespeare unit. They viewed the questions projected from a Power Point presentation, then texted the correct answer to my phone. This would have been VERY effective if the cell reception in my classroom had been better. The text arrived sporadically and not always in the order the students were sending them. They did really enjoy the activity, despite the reception problems.

Another teacher reported his use of the cell phone when he was absent from school.

> I was away from the building on a conference and left a detailed lesson plan for a project. Students were working in groups and were instructed to send me a cell phone picture of

> their finished project. When I received the first picture, I realized the students forget to label parts on their project. I quickly sent a text to tell them what needed to be done. Those students reminded the rest of the class to label. The projects were completed properly and the substitute reported that the students were engaged through the entire class period. I will use this method of accountability anytime I am away from the building.

One teacher reported increased achievement through the use of cell phone integration.

> I use [cell phones] as a review of what they are to know. I put one set of students in the hallway while another set are in the room. I ask the question. The ones in the room must text the answer to the ones in the hallway. The ones in the hallway come in and tell me what the question was. It gets extremely loud, however, when doing the phones we went from 20% knowledge to 85% knowledge.

Student accountability for learning was reported by another teacher when she integrated cell phone use with a lesson.

> Using cell phones for different lessons and activities allows the students to take ownership of the class content. The quicker those students can "use" what they learn, whether it is with a cell phone or other technology, the more likely they are to remember it. This will allow them to recall it cognitively and apply it when necessary. Teachers reported using cell phones to make their lessons relevant to the students.

Another teacher shared,

> I have used cell phones in my geometry class to take pictures of 3-D objects that the students find in the real world and to figure surface area, lateral area, and volume of each object. The students send me a picture of the object for accountability.

The real world application was evident in the following teacher response.

> Students have used their cell phones in my class in a scavenger hunt type activity. They were to find certain documents related to our lesson in the school, take a picture of them and then email them via text message to my email account. Students' behavior was well, and technology was used appropriately to my knowledge. Some students became a little more engaged, however, some of those who are the hardest to engage did not seem to be all that more enthusiastic about the activity.

One respondent used cell phones for safety purposes.

> Student cell phones are used as a secondary means of communication in my ECE and EP classes. For safety reasons, I can stay in contact with students when they are outside the classroom. If there is miscommunication, I can correct any relevant issues quickly, saving time, energy, and frustration. When on fieldtrips, I encourage students to bring cell phones for safety reasons.

Another teacher uses cell phones for the privacy they provide.

> Cell phones have enabled me to collect data from students in a private, quick, and effective manner. I have been able to quickly take opinion polls without spending a lot of class time. This has also allowed the students to give an honest opinion that is kept private.

Many teachers reported using the cell phone tools within their classroom setting.

> I have not specifically designed a lesson to use cell phones. I have, however, incorporated cell phones to have students text parents or to send reminders to themselves. I have had them use their calculator and apps such as a dictionary. I have also had them use the cameras. I have students use cell phones to take pictures of things, send me

messages, and play review games. Students used cell phones in a lesson to time their magazine article readings. This gave the students each the ability to see exactly how long their readings were. It was fun for them simply because a teacher let them take their phones out and use them for a classroom assignment. This is not usually allowed by teachers at our school. So the forbidden cell phone came out of hiding. Even with such a simple task, students were smiling and happy to bring their phones out in the open to use for class work.

I use whatever cell phone app I can think of. Use the stopwatch app for experiments, camera for documentation, text partners and attach pictures of collaborative projects done in virtual space, no physical contact between partners, all must be done electronically, curriculum was designed to be used with computers. I have been working to incorporate cell phones in all activities.

I have used cell phones as calculators, to poll students, to find information about a topic, to record information/projects, and to text proof of completion of work.

One particular teacher said, "Cell phones are used as they are needed–no formal plan–students choose what the best electronic device is to get a job done and use it." Another teacher shared his thoughts on this new technology

Like any technology, phones are a tool to be used for specific items that may be one facet of the lesson, but they are not yet developed to the point that they require no thinking skills on the part of the human. Apps are designed to do a particular task, not to replace critical thinking skills. One needs to define a problem and offer various apps as methods to solving the problem, but that is the point: they are a tool, like a hammer that is used in constructing a house, not a robot that can build the house for us without help. Therefore, I

> incorporate technology into lessons to achieve a means to an end. I use apps that speed us to the end of some drudgery and thats what the kids love–do it faster, do it better by automating sections of the work. I liken it to teaching kids to drive a stick shift versus an automatic–if you learn the stick shift, you can drive anything. If you learn the automatic first, you can drive an automatic but that's it. You are limited. Technology is automatic, working it into a problem solving lesson is like using a stick shift with an automatic option.

The teachers who responded that they had used cell phones in the classroom recognized the value that this technology tool was a way to encourage their students to become involved in their lessons. They provided me with practical ideas to integrate the use of the cell phone as well as the results of using the tool. Their responses were consistent with the literature review on cell phone integration. Teachers reported that students were smiling and happy while using their cell phones and enjoyed the activities as they were fun. Teachers also reported that students took ownership for and were accountable for their own learning when the cell phones were integrated into their lessons. The teacher summaries indicated that their cell phone lessons incorporated relevance and real world skills. In addition, there was evidence of positive student behavior when the cell phones were used in classrooms. Teachers provided examples of increased student achievement through the use of effective cell phone lessons. Critical thinking and problem solving skills emerged through the teacher reports of cell phones in the classroom.

Finally, from the definition of student engagement in Chapter 1, to the literature review on student engagement in Chapter 2, through the statistical results of data on student engagement in Chapter 4 and the teacher reflections documented in this chapter, student engagement is evident when cell phones are integrated in the classroom.

Although this study is based on the premise of teacher perception, I would have been remiss not to include those teacher summaries that cast a negative view on cell phone use. Of the 44 teachers who responded to the final section of the Teacher Technology Survey, 31.8% of them indicated that cell phones were banned in their schools and classrooms. While most of these 14 respondents were noncommittal on their perception of the use one teacher reported, "Our school does not allow cell phones in the classrooms, otherwise I'm sure I would use it to my advantage!" Another was very specific in her response, "Cell phones are against our school policy, and I'm not willing to break the rules for experimentation." A few teachers noted poor reception as a deterrent from using cell phones. "In many areas of the school, cell phone service is hard to maintain." "Cell phone signal is VERY limited. Even the kids say that my room is a bad room to do texting under the desk." "Cell phone reception at our school is inconsistent." "Students like the idea, but hard to implement due to poor service/reception."

Another issue expressed by teachers was the fear of distraction to learning when students are allowed to use their cell phones. "I'm concerned students will use their phones to text or otherwise stray from the lesson at hand. Unlike classroom computers, it is impossible to monitor most cell phone activity to keep students on task." "Students like to do other things once their cell phones are out." "I feel they would be more of a distraction and hindrance than educational." "A few years ago, our administration allowed students to have their cell phones on them at all times. It soon became a discipline issue, as students were using their phones to cyber bully, sext, disturb class, etc."

The digital divide was addressed by teachers who had concerns that not all students have access to cell phones. "Because some students do not have cell phones, it could be

discriminatory to require them for class work." "At times not all students had cell phones with them and thus are left out of certain activities."

> Not all students have cell phones. Not all cell phones are capable of doing the same applications. Some cell phones are simple, while others are far more advanced. In a school with a high population of low-income students, the idea that all students in a class would have cell phones with the capability of performing certain task is unreasonable–at least at this time.

Other teachers added,

> Not all students have Smartphones capable of multimedia. Some students will have the capability, but not all students. Additionally, the cell phone is a status for students. Those that do not have the latest phones may be embarrassed, and do not wish to be identified.

One other issue that concerned teachers was the knowledge of how to integrate cell phones in instruction. "If they were allowed, I have not done enough research on the topic to integrate these into my instruction." "Planning lessons with cell phones would be difficult because of the rapidly changing types of cell phones that students use." "I do not know how to do this."

The concerns documented by the respondents of this study included fear of inappropriate use of cell phones, discrimination due to the digital divide, school acceptable use policies, and the lack of professional development. Each of these concerns is consistent with prior research and indicative of why schools have been slow to embrace this new technology.

Implications

All entities of public high schools could benefit from this study. Administrators will see the importance of the hiring process and securing teachers who place high importance on the use of technology in their classrooms. They will have research to make informed decisions on lifting cell phone bans in their schools. In addition, this study will impress upon administrators the importance of the need for professional development before the implementation of new technology. Finally, administrators will see the cost saving benefits of allowing students to bring their own digital devices to school, lessening the need for the school to provide this technology.

Teachers, when seeing the relationship between technology and student engagement, will search for strategies to implement cell phone use in their lessons. They may recognize their own fears within this study and be willing to face those fears for the benefit of their students. With a better understanding of the digital divide teachers, will be armed with knowledge to help them better facilitate 21st century learning. Teachers need to understand that simply allowing students to use cell phones in the classroom does not assure learning. They will have to take a leadership role and guide their students to use the mobile devices effectively.

Students will be impacted in a positive manner when their administrators and teachers understand the relevance of implementing current technologies into their curriculum. Through the use of mobile devices students will have the opportunity to take control of their own learning and have access to the most up-to-date information available rather than be saddled with text book interpretations of any concept.

Recommendations for Further Research

1. This study focused on the perceptions of teachers in the Midwest. Further research could be conducted on a national level thus providing more statistical power. The

results could vary based on more teachers having had experiences integrating cell phone use in their classroom.

2. Although this study was conducted with teachers as respondents to the survey, it would benefit the educational profession to survey school administrators. Many of the teachers did not have the opportunity to participate in the full survey as their schools restrict the use of cell phones. Teachers are limited to the Acceptable Use Policies of their schools and those policies are administered by their school leaders. Information as to why school administrators feel the need to keep these restrictions in place would be beneficial.
3. Students are at the center of all educational decisions. Further research conducted through a quasi-experimental study using a pretest-posttest design with students would provide depth of insight into the student engagement component of this study.

Summary

Cell phones are the most ubiquitous technology in the world. They provide 24/7 connectivity, an opportunity for global collaboration, and in the hands of students provide critical thinking and problem solving capabilities. "Communications technologies have the potential to change schools and classrooms from isolated places with scare access to information environments with rich connections to the world and all its ideas." (Swan, van 'tHooft, Kratcoski, & Schneker, 2007, p. 514) Yet, it is the opinions and attitudes of teachers toward this mobile device that determine its' effectiveness as an instructional tool. Being exposed to information and developing knowledge about an innovation, such as a new technology, is the first step in adopting that innovation (Rogers, 1995). This study has provided the reader with information and knowledge about the juxtaposition of cell phone technology with traditional

teaching strategies for the purpose of engaging students in learning. I predict that as teachers realize the power of mobile technology to engage students in learning, they will adopt the revolutionary innovation as a go-to instructional tool.

REFERENCES

Akey, T. M. (2006). *School context, student attitudes and behavior, and academic achievement: An explanatory analysis.* New York, NY: MDRC. Retrieved January 12, 2012, from http://www.mdrc.org/publications/419/full.pdf

Albright, M. J. (1992). Teaching in the information age: The role of educational technology. *New Directions in Teaching and Learning, No. 51.* San Francisco, CA: Jossey-Bass.

Alexiou-Ray, J. A., Wilson, E., Wright, V. H., & Peirano, A. M. (2003). Changing instructional practice: The impact of technology integration on students, parents, and school personnel. *Electronic Journal for the Integration of Technology in Education, 2*(2), 7-9. Retrieved from http://ejite.isu.edu/Volume2No2/AlexRay.htm

Alfred, R. (2008, March 10). Mr. Watson, Come Here. *WIRED, 17*(3), 1. Retrieved from http://www.wired.com/science/discoveries

Altan, M. Z., & Trombly, C. (2001). Creating a learner-centered teacher education program. *Forum, 39*(3) 28-35. Retrieved June 14, 2011 from http://www.eric.ed.gov/ERICWebPortal/search/detailmini.jsp?-nfpb=true_&ERICExtSearch_Value_0=EJ648971

Alvermann, D. (2003*). Seeing themselves as capable and engaged readers: Adolescents and re/mediated instruction.* Retrieved from http://www.learningpt.org/literacy/readers.pdf

Australian Government Department of Education, Employment and Workplace Relations. (2001). *School factors influencing engagement: The task matters*. Retrieved from http://www.dest.gov.au/sectors/school_education/publications_resources/schooling_issues_digest/schooling_issues_digest_motivation_engagement.htm

Bain, A., & Ross, K. (2000). School reengineering and SAT-1 performance: A case study. *International Journal of Education Reform, 9*(2), 148-153.Retrieved June 12, 2011 from http://caret.iste.org/index.cfm?fuseaction=evidence&answerid=1

BBC News. (2007, December). *Keep Christmas gadgets "at home."* Retrieved from http://news.bbc.co.uk/2/hi/uk_news/education/7156326.stm

Becker, H. (1999). *Internet use by teachers.* Retrieved from http://www.crito.uci.edu/TLC/FINDINGS/internet-use/startpage.htm

Beeland, W. D. (2001). *Student engagement, visual learning and technology: Can interactive whiteboards help?* Retrieved August 20, 2011 from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.135.3542&rep=rep1&type=pdf

Betts, J. (2010). A study of the factorial invariance of the student engagement instrument (SEI): Results from middle and high school students. *School Psychology Quarterly, 25*(2), 84-93. Retrieved from http://www.ernweb.com/public/1212print.cfm

Billings, K. (2010). *Vision K-20.* Retrieved from http://www.siia.net/cision20/index.html

Blokdijk, G. (2008). *iPhone 100 need to know time savers*. Retrieved from http://avaxhome.ws/ebooks/engeneering_technology/iPhone100.html

Bomia, L., Beluzo, L., Demeester, D., Elander, K., Johnson, M., & Sheldon, B. (1999). *The impact of teaching strategies on intrinsic motivation.* Champaign, IL: ERIC Clearinghouse on Elementary and Early Childhood Education. (ED 418925)

Boss, S. (2008). *Overcoming technology barriers: How to innovate without extra money or support.*Retrieved from http://edutopia.org/technology-how-to-implement-classroom

Boster, F. J., Meyer, G. S., Roberto, A. J., & Inge, C. C. (2002). *A report on the effect of the united streaming™ application on educational performance*. Farmville, VA: Cometrika, , Baseline Research, & Longwood University.

Brabac, K., Fischer, K., & Pitler, H. (2004). Building better instruction: How technology supports nine research-proven instructional strategies. *Learning & Leading with Technology, 31*(5), 6-11. Retrieved from http://www.mcrel.org/topics/Products/236/

Brewer, K. R. W. (2007). Design-based or prediction-based inference? Stratified random vs stratified balanced sampling. *International Statistical Review, 67*(1), 35-47. Retrieved from http://onlinelibrary.wiley.com/doi/10.111/j.1751-5823.1999.x/abstract

Bridgeland, J. M., Dilulio, J. J., Jr., & Morison, K. B. (2006). *The silent epidemic: Perspectives of high school dropouts.* Washington, DC: Civic Enterprises. Retrieved from http://www.civicenterprises.net/pdfs/thesilentepidemic3-06.pdf

Cameron, D. (2005, December). *The net generation goes to university.* Paper presented at the Journalism Education Association Conference, Surfers Paradise, Queensland, Australia. Retrieved from http://live-wirez.edu.au/jea.papers/CAMERON.RTF

Center for Comprehensive School Reform and Improvement. (2006). *Bringing learning to life.* Retrieved from http://www.education.com/reference/article/Ref_Using_Positive/?F

Center for Digital Education. (2008). *A connected life: A look at mobile strategies for schools, colleges, and universities*. Folsom, CA: eRepublic. Retrieved from www.convergemap.com/paper/A-Connected-Life-A-Look-at-Mobile-Strategies-for-Schools-Colleges-and-Universitites.html

CEO Forum. (1999). *Professional development: A link to better learning.* Retrieved from http://www.ceoforum.org/reports.cfm?RID=2

Chao, C. C. (2005). *The validation of a measurement instrument: Teachers' attitudes toward the use of mobile technologies in the classroom.* Retrieved from http://ieeeexplore.ieee.org/search/freesrchabstract.jsp?-Yp+&arnumber=1508832&querytext%3Dthe+validation+if+a+measurement%3A++

Chapman, E. (2003). *Assessing student engagement rates.* ERIC Digest. (ED 482269). Retrieved from http://ericdigest.org/2005-2/engagement.html

Chen, B. (2011, May 24). Apple's app store surpasses half a million apps. *WIRED 20*(5), 1. Retrieved from http://www.wired.com

Christensen, C. M. (2008). *Disrupting class: How disruptive innovation will change the way the world learns.* New York, NY: McGraw-Hill.

Collins, A., & Halverson, A. C. (2009). *Rethinking education in the age of technology: The digital revolution and schooling in America.* New York, NY: Teachers College Press.

Collins, J. (2001). *Good to great: Why some companies make the leap and others don't.* New York, NY: Harper Collins.

Common Sense Media. (2010). *Hi-tech cheating: Cell phones and cheating in schools.* A National Poll. Retrieved from http://msnbcmedia.msn.com/i/MSMBC/Sections/NEWS/PDFs?2010_100202-CellPhoneSChoolCheating.pdf

Connell, J. P., & Wellborn, J. G. (1991). Competence, autonomy and relatedness: A motivational analysis of self-system processes. *Minnesota Symposium on Child Psychology, 23,* 43-77. Retrieved from http://www.thefreelibrary.com/Attachment+and+motivational+strategies+in+adolescence%3a+exploring

Conover, W. J., & Inman, R. L. (1981). Rank transformation as a bridge between parametric and nonparametric statistics. *The American Statistician, 35*(3), 124-129. Retrieved from http://dl.acm.org/citation.cfm?id=188429

Conrad, R. M., & Donaldson, J. A. (2004). *Engaging the online learner.* San Francisco, CA: Jossey-Bass.

Copeland, J. (2011, February). Taking it mobile: Success stories from the new frontier of untethered [*sic*] learning. *Florida Educational Technology Conference,* Orlando, FL.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience.* New York, NY: Harper & Row.

Csikszentmihalyi, M. (1996). *Creativity: Flow and the psychology of discovery and invention.* New York, NY: Harper Collins.

Cuban, L. (1986). *Teachers and machines: The classroom use of technology since 1920.* New York, NY: Teachers College Press.

Dawson, C. (2010, April 26). 50,000 android apps–just in time for the droid incredible. Retrieved from http://www.zdnet.com/bloggoogle/50000-android-apps-just-in-time-for-the-droid-incredible/2010

DeBell, M., & Chapman, C. (2006). *Computer and internet use by students in 2003* (NCES 2006–065). Washington, DC: National Center for Education Statistics.

DeLisio, E. R. (2007). *Crafting a workable cell phone policy.* Retrieved from http://educationworld.com/a_admin/admin393.shtml

DeLorenzo, R. (2009, June 29). *iPods in education part 12: Customized learning apps* [Web log post]. Retrieved from http://themobilelearner.wordpress.com/2009/06/ipods-in-education-part-12-apps/

Denig, S. (2004). Multiple intelligences and learning styles: Two complementary dimensions. *Teachers College Record, 106*(1), 96-111. Retrieved June 10, 2011 from http://www.tcrecord.org/Content.asp?ContentId=11513

Digital Millennial Consulting and Qualcomm Incorporated. (2007). *North Carolina Department of Education case study.* Retrieved http://www.projectknect.org/Project%20K-Nect/Needs%20Assessment.html

Ertmer, P., Ross, E., & Gopalakrishnan, S. (2007). *Technology-using teachers: How powerful visions and student-centered beliefs fuel exemplary practice*. Retrieved from http://www.edci.purdue.edu/ertmer/docs/SITE2_2000.pdf

Family Center on Technology and Disability. (2010, May). *STEM curricula in a technology-based UDL framework: A formula for narrowing the middle school science/male achievement gap? 107*(5), 2. Retrieved from htpp://www.fctd.info/newsletters/278

Fatemi, F. (1999, September 23). *Building the digital curriculum.*Retrieved from http://www.edweek.org/reports/tc99/articles/summary.html

Flickinger, B. (2010). *Schools technology solutions.* Retrieved from http://www.schooltechnology.org/2010/07/12/Edtech-technology-survey-shows-slow-growth

Freidman, T. (2000). *The lexus and the olive tree.* New York, NY: Random House.

Freud, S. (1989). *Civilizations and its discontents.* New York, NY: W.W. Norton.

Garcia-Reid, P., Reid, R., & Peterson, N. A. (2005). School engagement among Latino Youth in urban middle school context: Valuing the role of social support. *Education and Urban Society, 37,* 257-275. Retrieved from http://www.mdrc.org/publications/419/full.pdf

Gergen, K. (n.d.). *Cell phone technology and the challenge of absent presence*. Retrieved from http://www.swarthmore.edu/SocSci/kgergen1

Gillette, B. (2001). Sept. 11th terrorist attacks a factor in cell phone upswing. *The Mississippi Business Journal, 104*(11), 1-2.

Goldman, S., Cole, K., & Syer, C. (1999, July 12-13). *The technology/content dilemma.* Presented at The Secretary's Conference on Educational Technology, Washington, DC. Retrieved from http://www.ed.gov/technology/techConf/1999/whites/4.html

Gottfried, A.W., Fleming, J. S., & Gottfried, A. W. (2001). Continuity of academic intrinsic motivation from childhood through late adolescence: A longitudinal study. *Journal of Educational Psychology, 93,* 3-13. doi:10.1037//0022-0663.93.1.3

Grabe, C. A. (2001). *Integrating technology for meaningful learning.* New York, NY: Houghton Mifflin.

Gray, L., Lewis, L., & Thomas, N. (2010). *Teachers' use of educational technology in U.S. public schools: 2009*. (NCES 2010-040). Washington, DC: National Center for Education Statistics.

Grunwald, P., & Lippincott, R. (2011, June). The more we use it the more we love it. *THE Journal: Transforming Education Through Technology.38* (6), 34-35. Retrieved from http://thejournal.com/articles/2011/06/17/the-more-we-use-it-the-more-we-love-it.aspx

Harwood, P. G., & Asal, V. (2007). *Education: The first digital generation.* Westport, CT: Prager.

Hartwell-Young, E., & Heym, N. (2008). *How mobile phone help learning in secondary schools*. (A report to Becta). Retrieved from http://emerging.technologies.becta.org.uk/Index.php?section=etr&catcode=ETRE_0001&rid=14128

Heller, R., Calderon, S., & Medrich, E. (2003). *Academic achievement in the middle grades: What does research tell us? A review of the literature.* Atlanta, GA: Southern Regional Education Board. Retrieved from http://www.sreb.org/programs/hstw/publications/pubs/02V47_Achieve

Hobbs, V., & Christianson, J. S. (1997). *Virtual classrooms: Educational opportunity through two-way interactive television.* Lancaster, PA: Technomic.

Howe, D. W. (2007). *What hath God wrought: The transformation of America 1815-1848.* Oxford, UK: Oxford University Press.

Huitt, W., & Hummel, J. (2003). Piaget's theory of cognitive development. *Educational Psychology Interactive.* Valdosta, GA: Valdosta State University. Retrieved from http://www.edpsycinteractive.org/topics/cogsys/piaget.html

Illinois State Board of Education. (2002). *State of Illinois K-12 information technology plan revised 2000.* Retrieved from http://www.isbe.state.il.us/board/meetings/2000-2002/nov02meeting/digitalage.pdf

Jacobs, A. (2011, November). *Using mobile devices to increase student engagement.* SouthEast Education Network. *13*(3), 29-31. Retrieved from http://www.seenmagazine.us/articles/articles-details/articled/1803/using-mobile-devices-to-increase-student-engagement.asp

Jacobsen, D. M., Clifford, P., & Friesen, S. (2011, October). *New ways of preparing teachers for technology integration: What we did and how we did it.* Paper presented at Prairie Conference on Woman in Science and Engineering, Calgary, Alberta. Retrieved from http://www.ucalgary.cal~dmjacobs/papers/prairie_wise_2001.html

Jones, R. (2009). *Strengthening student engagement*. Rexford, NY: International Center for Leadership Education. Retrieved from http://www.leadered.com/pdf/Strengthen%20Engagement%20White%20 paper.pdf

Junco, R., & Timm, D. M. (2008). Using emerging technologies to enhance student engagement. *New Directions for Student Services, 124.* San Francisco, CA: Jossey-Bass.

Katz, J. E. (n.d.). *Mobile phones in educational settings* .Retrieved from http://cmcs.rutgers.edu/publications/articlesmobile%20phones%20in%20educational %20settings.pdf

Kay, K., & Honey, M. (2005). *Beyond technology competency: A vision of ICT literacy to prepare students for the 21st century*. Charleston, WV: The Institute of the Advancement of Emerging Technologies in Education.

Kearsley, G., & Shneiderman, B. (1999). *Engagement theory: A framework for technology based teaching and learning.* Retrieved from http://home.sprynet.com/~kearsley/engage.htm

Killion, J. (1999). *Critical issues: Providing professional development for effective technology use.* Retrieved from http://www.ncrel.org/sdrs/areas/issues/methods/technlgy/te1000.htm

Kobie, N. (2008). *ITPRO fit for business.* Retrieved from http://www.itpro.co.uk/ 611452/timeline-a-short-history-of-the-apple-iphone

Koedinger, K., Anderson, J., Hadley, W., & Mark, M. (1997). Intelligent tutoring goes to school in the big city. *International Journal of Artificial Intelligence in Education, 8,* 30-43. Retrieved from http://act-r.psy.cmu.edu/papers/231/jaied97.pdf_2.pdf

Kolb, L. (2011). Adventures with cell phones. *Educational Leadership, 68*(5), 39-43.

Kollie, E. (2011). Mobile technology for the classroom. *School Planning & Management, 50*(1), 80-82.

Kuenzi, J. (2008). Science technology, engineering, and mathematics (STEM) education: Background, federal policy, and legislative action. *Congressional Research Service Reports.* Paper 35. Retrieved January 20, 2012, from http://digitalcommons.unl.edu/crsdocs/35

Kvavik, R. B., Caruso, J. B., & Morgan, G. (2004). *ECAR study of students and information technology 2004: Convenience, connection, and control.* Boulder, CO: EDUCAUSE, Center for Applied Research. Retrieved from http://net.educause.edu/ir/library/pdf/ers0405/rs/ers0405w.pdf

Learning2Go. (2011). *Learning2Go: Wolverhampton LA mobile learning.* Retrieved from http://www.learning 2Go.org

Lei, J. (2009). Digital natives as preservice teachers: What technology preparation is needed? *Journal of Computers in Teachers Education*, *25*(33), 87-97.

Lindquist, D., Denning, T., Kelly, M., Malani, R., Griswold, W. G., & Simon, B. (2007). *Exploring the potential of mobile phones for active learning in the classroom.* Proceedings of the 38th SIGCSE technical symposium on computer science education, Covington, KY. doi:10.1145/122731.1227445

Little, J. W. (1990). The persistence of privacy: autonomy and initiative in teachers' professional relations. *Teachers College Record, 91,* 509-531. Retrieved from http://www.tcrecord.orgIDNumber:406

Maftoon, J. (1982). ITV: Are teachers using it? *Technological Horizons in Education*, *9*(2), 45-46. Retrieved from http://www.positivepractices.com/Education/Educational-Technology/1980-1989/.html

Mann, D., Shakeshaft, C., Becker, J., & Kottkamp, R. (1998). *West Virginia story: Achievement gains from a statewide comprehensive instructional technology program.* Santa Monica, CA: Milken Exchange on Educational Technology.

Manzo, K. K. (2009). Online learning policy and practice survey: A survey of the states. *Education Week, 29*(13), 5.

Marlar, J., Martin, T., Naile, J., Parker, A., Robertson, M., & Webber, G. (2007). *Teacher technology survey.* Athens, GA: University of Georgia. Retrieved from http://www.brobert.myweb.uga.edu/TeacherSurvey

Marzano, R., Marzano, J., & Pickering, D. (2003). *Classroom management the works:Research-based strategies for every teacher.* Alexandria, VA: Association for Supervision and Curriculum.

Marzano, R., Pickering, D., & Pollock, J. (2001).*Classroom instruction that works: Research based strategies for increasing student achievement.* Alexandria, VA: Association for Supervision and Curriculum Development.

McCaffey, M. (2011). Why mobile is a must. *The Journal Transforming Education Through Technology, 38*(2), 21-22.

McDaniel, R. (2012). *How can a smart board be beneficial to students' learning?* EHow Family. Retrieved from http://www.ehow.com/about_6635274_can-board-beneficial-students-learning-.html

McLaughlin, M. W., & Talbert, J. E. (1996). *Building school-based teacher learning communities: Professional strategies to improve student achievement.* New York, NY: Teachers College Press.

McMullen, A. (2011, April). *Transforming teaching and learning through technology-meeting the needs of 21st century learners*. Presented to the National School Board Association Conference, San Francisco, CA.

Middleton, S. (2011). *Engaging students with cell phones in the classroom.* Florida Technology Educators Conference, Orlando, FL. (Anytime, anywhere learning supported by Smart phones: Experiences and results from the MUSIS project). *Educational Technology & Society, 10*(4), 62-70.

Milken Exchange on Educational Technology. (1999). *Seven dimensions for gauging progress of technology in schools.* Retrieved from http://www.milkenexchange.org/projects.taf?

Milrad, M., & Spikol, D. (2007). *Integrating co-design practices into the development of mobile science collaboratories.* Stanford, CA: Stanford Center for Innovations in Learning.

Montgomery, K. (2009). *Generation digital: Politics, commerce, and childhood in the age of the Internet.* Cambridge, MA: The MIT Press.

Murray, J. (2008). Looking at the ICT literacy standards through the big6 lens.*Literacy Media Connections, 3,* 38-42. Retrieved from http://www.linworth.com/pdf/lmc/reviews_and_ articles/featured_articles/Murray_

Nagel, D. (2011, September). Will smart phones eliminate the digital divide? *The Journal, 27*(2), 23. Retrieved from http://thejournal.com/Articles/2011/02/011/Will-Smart-Phones-Eliminate-the-Digital-Divide

National Center for Education Statistics. (2006). *Fast facts.* Retrieved from http://nces.ed.gov/fastfacts/display.asp?id=46

Neilsen Company. (2009). *How teens use media.* Retrieved from http://blog.Neilsen.com/Nielsen/reports/Nielsen_howteensusemedia_june09.0dk

NetDay. (2006). *Our voices, our future: Student and teacher views on science, technology, and education.* Retrieved from http://www.netday.org/SPEAKUP/pdfs/SpeakUpReport_05.pdf

Netsu, R. (2006). Cellular phone technology in the classroom. *Asia University Journal Online, 14*(5), 27-31. Retrieved from http://www.asia-u.ac.jp/cele/cele_CELE%Journal%2006%Vol%2014/005Cell%20PhoneTEchnology%20in%20Classroom%20Ron.pdf

Newmann, F. (1986). Priorities for the future: Toward a common agenda. *Social Education, 50,* 240-250. Retrieved May 2011 from http://www.centerforcsrilorg/index.php?option=com_content&task=view&id=446&Itemid=5

November, A. (2010). *Empowering students with technology.* Thousand Oaks, CA: Corwin.

Oblinger, D., & Oblinger, J. (2005). *Educating the Net Generation. Educasue transforming education through information technologies.* Retreived July 2011 from http://net.educause.edu/ir/library/pdf/pub7101.pdf

Office of Technology Assessment. (1995). *Teachers and technology: Making the connection.* Washington, DC: U.S. Government Printing Office. Retrieved from http://www.wws.princeton.edu/~ota/disk1/1995/9541.html

Onwuegbuzie, A., & Leech, N. (2006). Linking research questions to mixed methods data analysis procedures. *The Qualitative Report, 11,* 474-498. Retrieved from http://www.nova.edu/ssss/QR/QR11-3/onwuegbuzie.pdf

Osborne, J. (2001). *Assessing metacognition in the classroom: The assessment of cognition monitoring effectiveness*. (Unpublished manuscript). Norman, OK: University of Oklahoma, Department of Educational Psychology.

Palfrey, J., & Gasser, U. (2008). *Born digital: Understanding the first generation of digital natives.* New York, NY: Basic Books.

Panel on Educational Technology, Presidents Committee of Advisors on Science and Technology. (1977). *Report to the President on the use of technology to strengthen K-12 education on the United States.* Retrieved from http://www.Ostp.gov/PCAST/l-12ed.html

Pavicich, C. (2008). The Watershed School selects Google Apps Education Editor to manage its cutting-edge curriculum. Retrieved from http://www.google.com/a/help/intl/en/edu/case_studies/watershed.html

Pecorino, P. A. (2004). *It's not power point, it's about pedagogy.* Retrieved from http://www.qcc.cuny.edu/SocialSciences/ppecorino/pedagogy-and-Technology.htm

Perry, D. (2003). *Handheld computers (PDAs) in schools.* Retrieved from http://www.becta.or.uk/corporate/press_out.cfm?id=2636

Postman, N. (1985). *Amusing ourselves to death.* New York, NY: Penguin Group.

Prensky, M. (2001). Digital natives, digital immigrants.*On the Horizon, 9*(5), 1-6. Retrieved from http://www.marcprensky.com/writing/Prensky%20-%20Digital%Natives,%20Digital%Immagrants%20-%20Part1.pdf

Prensky, M. (2005). *Don't bother me mom I'm learning*. St Paul, MN: Paragon House.

Prensky, M. (2010). *Teaching digital natives.* Thousand Oaks, CA: Corwin.

Project Tomorrow. (2010a). *Project k-nect evaluation report.* Retrieved from http://www.tomorrow.org/research/ProjectKnect.html

Project Tomorrow. (2010b). Creating our future: Students speak up about their vision for 21st century learning. Retrieved from http://tomorrow.org/speakup/pdfs/SU09National FindingsStudents&Paraents.pdf

Quinn, C. N. (2005). *Engaging learning.* San Franscisco, CA: Pfeiffer.

Quinn, D. M., Gruenert, S. W., & Valentine, J. W. (1999). *Using data for school improvement.* (National Alliance of Middle Level Schools, Turning Points: Recommendations into Action Monograph). Reston, VA: National Association of Secondary School Principals. Retrieved from http://educationMissouri edu/org/mllc/Upload%20Area-Docs/IPI%20Manuscript%2012-07.pdf

Rainie, L. (2006). *Digital "natives" invade the workplace.* Pew Internet & American Life Project. Retrieved from http://pewresearch.org/pubs/70/digital-natives-invade-the-work-place

Rakes, G. C., & Casey, H. B. (2002). An analysis of teacher concerns toward instructional technology. *International Journal of Educational Technology, 3*(1). Retrieved from http://www.ed.uiuc.edu/ijet/v3n1/rakes/index.html

Ray, B. (2008, July 30). Connecting STEM and ARTS (TEAMS) to spur U. S. innovation. [Web Post Blog]. Retrieved from http://www.edutopic.org/blogs

Reeve, J. (2006). Teachers as facilitator: What autonomy-supportive teachers do and why their students benefit. *The Elementary School Journal, 106,* 225-236. Retrieved from http://www.journals.uchicago.edu/ESJ/journal/Publisher

Richtel, M., & Stone, B. (2009, February 15). Industry makes pitch that smart phones belong in classroom. *The New York Times.*Retrieved from http://www.nytimes.com/ 2009/02/16technology/16phone.html

Rideout, V. J., Foehr, U. G., & Roberts, D. F. (2005). *Generation M: Media in the lives of 8-18 year-olds.* Washington, DC: Kaiser Family Foundation. Retrieved from http://www.kff.org/entmedia/index.cfm

Rodgers, K. D. (2011). *Mobile learning devices (essentials for principals).* Bloomington, IN: Solution Tree.

Rogers, E. (1995). *Diffusion of innovations.* Retrieved from http://www.stanford.edu/class/symbsys205/Diffusion%20of%20Innovations.htm

Rosen, C. (2004, Summer). Our cell phones, ourselves. *The New Atlantis, 6*, 26-45. Retrieved from http://www.thenewatlantis.com/publications/our-cell-phones-ourselves

Rosen, L. D. (2010). *Rewired.* New York, NY: Palgrave McMillian.

Rosen, L. D. (2011). Teaching the igeneration. *Educational Leadership, 68*(5), 10-15.

Saettler, P. (2004). *The evolution of American educational technology* (Vol. 128). Greenwich, CT: Information Age Publishing.

Sandholtz, J. H., Ringstaff, C., & Dwyer, D. C. (1997). *Teaching with technology.* New York, NY: Teachers College, Columbia University.

Schachter, R. (2009). Mobile devices in the classroom. *District Administration, 45*(10), 31. Retrieved from http://www.districtadministration.com/article/mobile-devices-classroom

Scherer, M. (2011). Transforming education with technology. *Educational Leadership, 68*(5), 17-21.

Schiefele, U. (1991). Interest, learning, and motivation. *Education Psychologist, 26*, 299-323. Retrieved from http://www.unco.edu/cebs/pshcyology/kevinpugh/6-8140/Schiefel.html

Schrum, L. (1999). Technology professional development for teachers. *Educational Technology Research and Development, 47*(4), 83-90. Retrieved from http://www.fga.it/Leftwich_Teacher_Technology_ProfessionalDevelopment

Schrum, L., & Levin, B. B. (2009). *Leading 21st century schools: Harnessing technology for engagement and achievement.* Thousand Oaks, CA: Corwin.

Schweinle, A., Meyer, D. K., & Turner, J. C. (2006). Striking the right balance: Students' motivation and affect in elementary mathematics. *Journal of Educational Research, 99,* 271-293. Retrieved from http://www.centerforsci.org/reserach/improvement.cgi?st=S&sr=SR005351

Selwyn, N., & Gorard, S. (2003). Reality bytes: Examining the rhetoric of widening educational participation via ICT. *British Journal of Educational Technology, 34*(2), 169-181. Retrieved from http://www.blackwellpublishing.com

Shuler, C. (2009). *Pockets of potential: Using mobile technology to promote children's learning.* Retrieved from http://joanganzcooneycenter.org/Reports-23.html

Skinner, B. F. (1958). Teaching machines. *SCIENCE, 128*(3330), 969-977. Retrievedfrom http://www.bfskinner.macwebsitebuilder.com

Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom: Reciprocal effects of teacher behavior and student engagement across the school year. *Journal of Educational Psychology, 85,* 571-581. Retrieved from **Error! Hyperlink reference not valid.**motivation-in-the-classroom-skinner-belmont-1993/

Skinner, E. A., Kindermann, T. A., & Furrer C. J. (2008). A motivational perspective on engagement and disaffection: Conceptualization and assessment of children's behavioral and emotional participation in academic activities in the classroom. *Educational and Psychological Measurement Online First.* doi:10.1177/0013164408323233.

Smith, B. K., & Blankenship, E. (2000). Justifying imagery: Multimedia support for learning through exploration. *IBM Systems Journal, 39,* 749-768. Retrieved from http://www.citelike.org/user/ianli/author/Blankenship

Soloway, E., Norris, C., Blumenfield, P., Fishman, B., Krajcik, J., & Marx, R. (2001). Handheld devices are ready at hand. *Communications of the ACM-CACM, 44*(6), 15-20. Retrieved from http://www.citeseerx.ist.psu.edu/showciting?cid=213182

Stansbury, M. (2011). Mobile learning at a tipping point. *eSchool News, 14*(1) 1-30. Retrieved from http://www.eschoollnews.com/2010/10/29/survey-mobile-learning-at-at-tipping-popint/

Swan, K., van ‘tHooft, M., Kratcoski, A., & S. Chenker, J. (2007). Ubiquitous computing and changing pedagogical possibilities: Representations, conceptualizations and uses of knowledge. *Journal of Educational Computing Research, 36*, 481-515.

Tapscott, D. (1998). *Growing up digital.* New York, NY: McGraw-Hill.

Tapscott, D. (2009). *Grown up digital.* New York, NY: McGraw-Hill.

Tinto, V. (1997). Classrooms as communities. *Journal of Higher Education, 68,* 599-623.

Trump, K. S. (2007). *Cell phones and text messaging in schools.* Retrieved from http://www.schoolsecurity.org/trends/cell_phones.hrmi

Twidale, M., Nichols, D., & Paice, C. (1996). *Browsing is a collaborative process.* TechnicalReport CSEG/1/96, Computing Department, Lancaster University. Retrieved from http://www.comp.lancs.ac.uk/computing/research

Ullman, E. (2011). BYOD and security: How do you protect students from themselves? *Tech & Learning: Ideas and Tools for Ed Tech Leaders, 31*(8), 32-36.

U.S. Department of Education. (2006). *Internet access in U.S. public schools and classrooms: 1994-2005* (NCES 2007-020). Washington, DC: National Center for Education Statistics.

Vedova, T. (2011). *When technology fails to succeed.* [Web log post]. Retrieved from http://1teachonthedge.blogspot.com/2011/009/when-technology-fails-and-we-succeed.html

Vision K-20. (2010). Retreived May 12, 2011 from http://siia.net/visionk20/index.html

Wagner, E. D. (2008). Enabling mobile learning. *EDUCAUSE Review, 40*(3) 40-53.

Walsh, J., & Sattes, B. (2011). *Thinking through quality questioning: Deepening student engagement.* Thousand Oaks, CA: Corwin.

Wilson, B. G., & Peterson, K. (1995).*Successful technology integration in elementary schools: A case study.* Retrieved from http://carbon.cudenver.edu/-bwilson/peakview.html

Wishart, J., & Blease, D. (1999). Theories underlying perceived changes in teaching and learning after installing a computer network in a secondary school. *British Journal of Educational Technology, 30*(1), 25-41. doi: 10.1111/1467-8535.00088

Yazzie-Mintz, E. (2010). *Charting the path from engagement to achievement: A report on the 2009 high school survey of student engagement.* Bloomington, IN: Center for Evaluation & Education Policy. Retrieved from http://ceep.indiana.edu/Hssse/images/HSSSE_2010_Report.pdf

Young, J. (2011, February). *Next-generation learning technologies: Catalyst for education reform?* Presented to the Florida Educational Technology Conference.Orlando, FL.

APPENDIX A

Cover Letter

Dear xxxxxx,

I am a doctoral candidate in the Educational Leadership department at Indiana State University. I am working under the leadership of Dr. Steve Gruenert, my committee chair. I am conducting research to study teacher attitudes toward enhancing the educational environment through the use of mobile technology as an instructional tool.

This study is designed to gather the input of 500 secondary public school teachers from Illinois, Indiana, Kentucky, Michigan, and Ohio. The purpose of the study is to determine to what effect there are benefits to teaching and learning when using mobile technology as an instructional tool. Teacher attitudes, proficiencies, and relevancy will be queried.

While the validity of the results depends on a high rate of return, please understand that your participation is voluntary and there is no penalty for those who choose not to participate in the study. Please be assured that your responses will be held in the strictest confidence. There are no known risks if you decide to participate in this research study.

The electronic survey should take just eight-ten minutes to complete. No identifying information including names, e-mail addresses or IP addresses will be collected. Should the data be published, no individual information will be disclosed. Please go to the following link to participate: http://xxxxxxx.

At the end of the survey you will be asked if you would be willing to participate further by integrating cell phones into a lesson in your content area. Should you decided to teach this lesson the researcher will provide you with a pre-planned lesson plan that can be easily adapted to any content area. Your participation in teaching the lesson will help to provide richness and depth to this study. You may withdraw from the study at any time, there will be no penalty. If you are not interested in teaching the lesson you simply mark NO on the survey.

If you have any questions regarding this study, please contact my committee chair or myself. If you any questions about your role as a research participant, please contact the Indiana State University Institutional Review Board at IRB@indstate.edu or (812)237-8217.

I am grateful for your participation as I understand that the demands on your time are significant. Thank you in advance, for your participation in this study.

Sincerely,

Kathryn D. Goad (Doctoral Candidate)
Phone: (574) 583-8299
goadk@trico.k12.in.us

Dr. Steve Gruenert (Committee Chair)
Phone: (812) 238-2902
steve.gruenert@indstate.edu

APPENDIX B

Follow-Up Letter

Dear XXXXXXX,

A few weeks ago I e-mailed you inviting you to participate in a study of teacher attitudes toward enhancing the educational environment through the use of mobile technology as an instructional tool.

If you have already completed the survey, please accept my sincere thanks for your valuable responses.

If you have not yet completed the survey, please consider doing so. While I know the demands on your time are great, the survey should take just eight-ten minutes to complete. There is little current research on the use of mobile technology in the classroom. Your responses to this groundbreaking research will add richness and depth to a study which can benefit the educational profession.

Your responses to this survey will be kept in strict confidence. No identifying information including e-mail addresses, IP addresses or names will be collected. Should the data be published, no individual information will be disclosed.

At the end of the survey you will be asked if you would be willing to participate further by integrating cell phones into a lesson in your content area. Should you decided to teach this lesson the researcher will provide you with a pre-planned lesson plan that can be easily adapted to any content area. You may withdraw from the study at any time, there will be no penalty. If you are not interested in teaching the lesson you simply mark NO on the survey.

Please follow the link to participate in the study http://XXXXXXXXXXXXX.
If you have any questions about your rights as a research subject or if you feel you've been placed at risk you may contact the Indiana State University Institutional Review Board (IRB) at IRB@indstate.edu or (812) 237-8217.

Thank you for your participation in this study.

Sincerely,

Kathryn D. Goad
Doctoral Candidate, Indiana State University

APPENDIX C

Survey

Technology Survey for Teachers

Section 1: General Teacher Information

1. I am a:

__male

__female

2. I teach the following subjects (check all that apply):

__Art

__Business

__Computer Lab Classes

__English as a Second Language

__Foreign Language

__Health and/ or Physical Education

__History and/or Social Studies

__Industrial Technology

__Language Arts

__Mathematics

__Music

__Reading

__Science

__Special Education

__Vocational Education

__Other

3. As a technology user, I classify myself as:

__Not yet

__Beginner w/support

__Confident on my own

__Capable of teaching others

4. I have the following experience using technology with students:

__Not started yet

__1 year

__2-3 years

__4-5 years

__5+ years

5. I classify my ability to design and assess lessons supported with technology resources for students as:

__ Not yet

__ Beginner w/support

__ Confident on my own

__ Capable of teaching others

6. I rate my frequency of technology use with students:

__Seldom or never

__2 – 4 times a year

__Monthly

__Weekly

__Daily

7. The percentage of my students proficient with technology:

__Not sure

__Less than 25% of students are proficient

__25 – 49% of students are proficient

__50 – 75% of students are proficient

__76%+ of students are proficient

Section 2: General Technology use in Education

The questions in this section ask about general technology use. Please read each statement and rate your skill and the importance you place on each of the tasks by circling the number that corresponds to your response.

Level of Proficiency	Level of Importance
1 Very weak	1 None
2 Moderately weak	2 Minor
3 Adequate	3 Average
4 Moderately strong	4 Strong
5 Very strong	5 Necessary

Competency	Proficiency	Importance
Learning how to use a new piece of software	1 2 3 4 5	1 2 3 4 5
Using the Internet for general searching	1 2 3 4 5	1 2 3 4 5
Acting as a guide for students when researching on the Internet	1 2 3 4 5	1 2 3 4 5
Troubleshooting problems that occur when using technology	1 2 3 4 5	1 2 3 4 5
Using software productivity tools (word processing, database, spreadsheets, presentations tools, etc.)	1 2 3 4 5	1 2 3 4 5
Integrating technology into daily lessons	1 2 3 4 5	1 2 3 4 5
Teaching and sharing with others how to use technology	1 2 3 4 5	1 2 3 4 5
Using technology in support of curriculum standards	1 2 3 4 5	1 2 3 4 5
Locating learning opportunities needed to advance my technology skills	1 2 3 4 5	1 2 3 4 5

Section 3: Specific Technology use in the Classroom

The questions in this section ask about the specific technologies you use in your classroom and the frequency with which you use them. Please read a description of each technology and rate the amount of time you spend working with that technology in your classroom.

Technology Description	Never	Yearly	Monthly	Weekly	Daily
SOFTWARE					
Word Processing					
Presentation Tools					
Desktop Publisher					
Test Preparation					
Spreadsheets					
YouTube					
Web Design					
Student Management System					
HARDWARE					
Computer					
Television					
DVD/VHS Player					
Projector					
Interactive Whiteboard					
Digital Camera (still)					
Digital video camera					
Mobi					
Document camera					
iPod					
Cell Phone					

Section 4: Opinions and Attitudes toward Technology

The questions in this section ask for your honest opinions about different technologies, their role in education, and the future of different technologies.

When using technology…	Strongly Agree	Agree	Disagree	Strongly Disagree
Students create products that show higher levels of learning				
There are more discipline problems				
Students are more motivated				
There is more collaboration				
Students do inappropriate things				
I believe…				
Electronic media will replace printed text within five years				
Most technology would do little to improve my ability to teach				
Technology has changed the way I teach				
Students are more knowledgeable than I am when it comes to technology				
School systems expect us to learn new technologies without formal training				
There is too much technological change coming too fast without enough support for teachers				
Technology has left many teachers behind				
Technology is a good tool for collaboration with other teachers when building unit plans				
Technology is unreliable				
Bring your own technology will be a standard practice in schools in within the next five years				

Section 5: If you have integrated the use of student cell phones in a content lesson please write a summary of that experience. If you have never integrated the use of student cell phones in a content lesson please write a paragraph on why you have chosen not to use this specific technology.

Thank you for taking part in this survey. Your information has been invaluable.

APPENDIX D

Permission to Reprint

Kathy Goad - Re: Permission To Use

From: Jing Lei <jlei@syr.edu>
To: Kathy Goad <GoadK@trico.k12.in.us>
Date: 3/19/2012 5:15 PM
Subject: Re: Permission To Use

Dear Kathy,

You have my permission to use this table (appropriate citation or acknowledgment would be appreciated).

Best,

Jing

Jing Lei, Ph.D.
Associate Professor
Instructional Design, Development & Evaluation,
School of Education
Syracuse University
336 Huntington Hall
Syracuse, NY 13244
Phone: (315)443-1362
Fax: (315)443-1812
Website: http://faculty.soe.syr.edu/jlei/

From: Kathy Goad <GoadK@trico.k12.in.us>
Date: Mon, 19 Mar 2012 12:03:34 -0400
To: Jing Lei <jlei@syr.edu>
Subject: Permission To Use

I am a doctoral students at Indiana State university. I am writing my dissertation on the use of cell phones in the classroom. I am writing to you in hopes of securing permission to use a table published in the Journal of Computing in Teacher Education. You authored the article Digital Natives as Pre-Service Teachers: What Technology Preparation is Needed?. I am using the table on Beliefs, Confidence, and Interest in Technology to support my hypothesis. I would appreciation written permission to use this table as published.

Thank You,

Kathy Goad
Principal
Tri-County Middle Senior High School
11298 W 100 S
Wolcott, IN 47995
219-279-2105

Don & Kathy Goad

From: Palgrave, Rights <Rights@Palgrave.com>
Sent: Monday, March 14, 2011 11:10 AM
To: Don & Kathy Goad
Subject: RE: Requesting right to use Table in Dissertation

Dear Kathryn D. Goad;

RE: Permission to use Table 2.1 and 2.2 from Rewired by Rosen in a dissertation

it is our policy to grant permission free of charge to students who are looking to quote excerpts from our titles for strictly academic purposes. This is subject to the following conditions:

- Your work must be of a entirely academic nature; no commercial publication of the work at hand is allowed;
- You must acknowledge our edition directly below the reproduced material as follows : «author/editor, title, year of publication, publisher (as it appears on our copyright page) reproduced with permission of Palgrave Macmillan. This material may not be copied or reproduced without permission from Palgrave Macmillan»

Your thesis may be reproduced through academic aggregators but should it become eligible for commercial publication at a later stage, you will need to re-apply for our permission.

Best wishes

Lauren Russell
Rights Co-ordinator
Palgrave Macmillan
Houndmills
Basingstoke
Hampshire
RG21 6XS
+44 (0)1256 329242 Ext. 3518
fax +44(0)1256 353774

From: Don & Kathy Goad [mailto:dkgoad@comcast.net]
Sent: 09 March 2011 17:06
To: Palgrave, Rights
Subject: Requesting right to use Table in Dissertation

Thank you for contacting the Rights department at Palgrave Macmillan. Please provide details of the title, author and ISBN of the Palgrave book you wish to license material from, and the rights that you require.

I am a doctoral student at Indiana State University writing to request the right to use two tables in my dissertation. Below is the information from the publication that I would like to use.