11-14-2013

Students' Acquisitions of 21st Century Skills Using and Integrating Technology

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STUDENTS' ACQUISITIONS OF 21ST CENTURY SKILLS USING AND INTEGRATING TECHNOLOGY

by

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A Dissertation

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Doctor of Education

Major: Instruction and Curriculum Leadership

The University of Memphis

December, 2013

Dedication

This dissertation is not a piece of work that I could have completed alone. It is dedicated to my loving and encouraging husband, Justin Hallock, who has consistently been there for me; my wonderful parents, Charles and Dale Hill, who have supported me and given me the confidence to succeed; my grandmother, Ellen McKinstry Surber, whose generous support and love for education has been a true motivation; and, finally, to Taylor and Deacon who have sat at my side throughout the process.

Acknowledgements

Heartfelt gratitude is expressed to:

Dr. Duane M. Giannangelo, Dr. Louis A. Franceschini, Dr. Jeffrey M. Byford, Dr. Ramona Mahood, and Dr. Allen H. Seed of the University of Memphis for their encouragement, guidance, and expertise;

Dr. Ed Miller, Dr. David Asbury, and the principals, school coordinators, and teachers of the Gadsden City School System for their cooperation and help in securing teacher data;

Mr. Pete Johnson, Mrs. Jessica Tate, Mrs. Claire Smith, Ms. Mattie Smith, and the teachers, staff, and students at Grahamwood Elementary School for their inspiration and support;

Finally, every person who expressed interest, offered support, made a suggestion, or otherwise contributed to the successful completion of this study.

Abstract

Hallock, Melinda Hill, EDD. The University of Memphis. December, 2013. Students' Acquisitions of 21st Century Skills Using and Integrating Technology. Dr. Duane Giannangelo:

The purpose of this study is to explore teachers' use of technology to determine the ways technology is being used and if teachers are teaching the skills necessary to prepare their students to be successful in the 21st century. Technological skills should be embedded in schools' curriculum as students are learning the skills necessary to compete in the 21st century. The sample consisted of 123 teachers at 12 public schools to determine if technology is being used in the classroom and if so, the extent to which it is being used. More specifically, this study seeks to address whether or not there are significant differences among teachers at varying grade levels, years of experience, different ages, and different levels of education.

Using Analysis of Variance, a highly significant difference in mean level of technology use was observed by teachers' grade level ($F(3,116) = 11.92$, $p < .001$). Also, using the ANOVA to test for differences among the subgroup means suggests a statistically significant differences by grade level ($F(3,116) = 3.18$, $p = .027$)—such that the mean for Grades 3 through 5 ($M = 3.94$, $SD = 0.84$) differs from that for Grades 9 through 12 ($M = 3.36$, SD = 0.73). Modest correlations were observed between technology usage and problem-solving ($r = .278$), critical thinking ($r = .301$), collaboration ($r = .304$), and especially, creativity/innovation ($r = .329$). As regards to the relationships between technology integration and the skills of collaboration ($r = .409$), problem-solving ($r = .461$), critical thinking ($r = .455$), and creativity and innovation (r = .438), the remaining correlations all exceed a value of $r = .40$ (moderate relationship) and

all are highly statistically significant (at $p < .001$). The correlations observed between perceptions of classroom impact and students' development of skills for collaboration ($r = .513$), critical thinking ($r = .525$), problem-solving ($r = .557$), and creativity and innovation ($r = .566$). Schools can use this to bring more professional development to weak areas and continue to strengthen the 21st century skills using technology.

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Chapter 1

Recognition of the Problem

In the current study, the use of technology in classrooms to equip students with the skills they need to achieve in the 21st century is being examined because the modern-day classroom differs from the classroom of the past. In 1650, the hornbook and the wooden paddle with writing were the face of "new inventions." Both the chalkboard (developed in 1890) and the pencil (invented in 1900) made students' and teachers' lives easier. Later in 1930, the overhead projector made its debut in the classroom (Dunn, 2011). Yet, few teachers today still use the overhead projector, as it is being replaced by technological devices such as document cameras, interactive whiteboards, iPads, laptops, and Web 2.0 (Morrison & Lowther, 2010). However, despite these technological advances, some teachers are still using technology minimally. Nonetheless, many other teachers are incorporating technology in their daily lessons with great student success (Betrus & Molenda, 2002; Pilgrim, Bledsoe, & Reily, 2012). Therefore, the current investigation in which I seek to determine the degree to which teachers are using technology in their classrooms is relevant. This study is also warranted because both companies and colleges are expressing frustration with students' preparedness upon completion of their high school diplomas. According to Trilling and Fadel (2009), students at the high school level are not learning how to collaborate with their peers or how to think critically, and they lack basic technology skills, such as typing, researching, and performing basic Word operations. Thus, a study of the degree to which teachers are using technology in their classrooms is warranted.

In today's society, certain skills are necessary for an individual to be successful in college and for someone to compete for and maintain a "quality" job. These skills, referred to throughout this study as 21st century skills, include creativity and innovation, critical thinking, problem solving, research and information fluency, written and verbal communication, and collaboration (Jacobs, 2010; Trilling & Fadel, 2009). It is critical to determine if teachers are indeed teaching these skills, as these skills will enable some degree of success after high school whether a graduate chooses to go to college or start a career immediately. Acquiring these 21st century skills will not only teach students how to rationally discuss and solve problems, but will prepare them for the future. The high school graduates of the 21st century are the people who will be responsible for discovering different ways to preserve our land, bodies, and lives for generations to come.

Technological Implementation in the Learning Environment

Jacobs (2010)—considering the way classrooms are arranged, instruction is given, and confinement of time contributes to high dropout rates, lack of technical skills, and students' poor research and collaboration skills—argues that schools are positioned to educate children for the 19th century. The educational system is remaining stagnant while the student body as well as the world around them evolves. According to Blair (2012), elementary-aged students own and use cell phones for different purposes, such as texting. Blair also states that children 5 and 6 years of age are able to interpret software on iPads and iPods better than adults and that students in middle school and high school are using the Web to post blogs and to "tweet." Students use technology everyday outside of the school setting, and many of these students will use technology in their careers once they

complete their schooling. It is essential that schools reinforce the use of technology so that students are prepared for future professions (Morrison & Lowther, 2010).

Some of the students entering the workforce straight from high school lack the knowledge and skills needed to be successful in corporations and businesses in the 21st century (Casner-Lotto & Barrington, 2006). As Pilgrim et al. (2012) state, "Jobs require professionals to use the Web and tools such as wikis, blogs, and digital content for research, collaboration, and communication" (p. 16). Even if a job does not require the direct use of technology, an employee may be required to use technology to communicate or collaborate with his or her boss or co-worker and possibly to solve problems. The educational system is responsible for providing students with these skills to aid their success in the future.

According to the 2009 National Assessment of Educational Progress report, the average reading and math standardized test scores for 17-year-old students have not changed since the 1970s (Zehr, 2012). Although the reading and math scores for elementary students have increased slightly, it is still difficult to state that the education system is providing the tools students need to succeed in the 21st century. Not only are American students' scores not improving, but students in the U.S. cannot compete with the students from other countries on standardized tests (U.S. Department of Education, 2009). According to International Test Scores (2011), U. S. students in 4th grade were ranked at 12 of 26 nations, U. S. students in 8th grade were ranked at 28 of 41 nations, and U. S. students in 12th grade were ranked at 19 of 21 nations. As these statistics show, U. S. schools are not headed in the right direction. Teachers should not continue to teach the same way they taught in the 1970s. The school systems in the United States must be

transformed for U. S. students to compare to students from other nations (Trilling & Fadel, 2009).

The Importance of Using Technology

When technology is used in the classroom, the benefits definitely outweigh the costs, and effective use of technology enhances teachers' instructional time. By learning skills that enable them to take ownership of their learning and to work collaboratively with their peers, students are able to become active members of society. Technology allows students to become more independent learners (Rubenstein, 2010). As Lentz and Boe (2004) said, technology allows students to "develop inventive thinking skills, brainstorm ideas, plan designs, and evaluate solutions" (p. 20). With the use of technology, teachers are able to pose research questions for the students to so that they can work together and use the Internet to find solutions. Students who were once passive learners can take control of their own learning and become active learners (Koch & Burghardt, 2002).

Allowing students to use technology to collaborate on assignments prepares them to work in a real-world setting. Studies have shown that when students are not given group projects and are working individually, they will ask their peers for help instead of asking the teacher (Singh & Means, n.d.); this means that students become coaches and tutors (Koch & Burghardt, 2002). Wetzel, Zambo, and Padgett (2001) witnessed an overall classroom change pertaining to the class environment and students' attitudes when students started using computers in the classroom. Prior to the use of computers, the students had problems getting along and working in groups. However, once laptops were introduced, students paid less attention to whom they worked with. These students

knew their classmates with technological skills, and they were willing to work with any classmate who could be of assistance (Wetzel et al., 2001). Not only did these students start to discuss their questions, but they also became more receptive to each other's ideas. In this study (Wetzel et al., 2001), school became a place to rationally discuss ideas and opinions in a manner that benefitted the children.

For many years, there has been a multidisciplinary approach to educators as different subjects are being integrated; technology allows teachers to integrate these subjects with more ease. Western (2003) surmises that technology should not be the main focus of a lesson, but it should only be used to augment a concept. Western uses spreadsheets to teach math, digital cameras to teach counting, calculators to enhance multiplication skills, and scanners to promote coin-counting (Western, 2003). Technology can be used in classrooms regardless of subject area or grade level, as it is used to enhance the topics being studied while keeping the students engaged.

Technology also allows students to explore meaningful topics in more depth. Rubenstein (2010) mentioned pen pals, in which students make "friends" from all over the world and learn about different cultures. In the past, this was done by transmitting letters via traditional mail; however, the Internet makes pen pal communications faster and more cost-efficient. Students can also go on virtual field trips, exploring Vatican City or admiring the Christ Statue in Rio de Janeiro without having to leave the classroom. Students should understand the reasons they learn about certain topics and understand how the knowledge they learn can be applied to their lives. Technology allows instructors to present real-world problems to their students, and this can be done by students reading news articles or using search engines to find information related to the topic. Through

technology, it is easier for teachers to incorporate current events into their daily lessons and allow students to do their own research (Curtis, 2003).

Once teachers realize that technology allows students to develop a deeper understanding of concepts and provides ways to apply those concepts to real-world experiences, then they will better understand the need to use technology in their classrooms. Today, many classrooms are filled with a plethora of technological contraptions. Too many teachers, however, are allowing their technological devices to collect dust or to be used only as "time fillers" for the students to play games instead of using it as a meaningful teaching and learning tool (Morrison & Lowther, 2010).

Rationale

The use of technology in schools has been examined quite a bit in the literature. However, here in the 21st century, school systems, teachers, and students are seeing an influx of computers in their classrooms. Teachers are trained to use technology through teacher education programs and professional development sessions, as technology is a major component of our society and is changing at such a rapid pace. Today, it is necessary that teachers are able to utilize technology during their daily teaching (Morrison & Lowther, 2010; Rubenstein, 2010).

The number of computers in classrooms has increased significantly since the 1980s. In 1981, only 18% of classrooms had a single computer; by 1987, this number rose to 95%. The U.S. Department of Education (as cited in Gray, Thomas, & Lewis, 2010) determined that 98% of the teachers at the elementary level have more than 1 computer in their classrooms. The U.S. Department of Education (2010) also identified that in 2009, there was one computer for every 5.3 students. Considering this increase in

the numbers of computers in classrooms, it is essential to determine if teachers are using their computers to benefit the students, if the computers are collecting dust, or if the computers are being used only as time-fillers (Morrison & Lowther, 2009).

Another reason we should re-examine the use of technology in classrooms is to determine if professional development and teacher education programs are actually providing "technology readiness." Most teacher education programs require prospective teachers to take a course on how to teach with technology. Other requisite methods courses in teacher education programs also incorporate the use of technology (Betrus & Molenda, 2002). It is essential that teacher education programs expose these students to the latest trends in technology and education (Betrus & Molenda, 2002; Morrison & Lowther, 2010). In addition, many veteran teachers are exposed to the latest technological advances through professional development and the evaluation process. Many states have started to include a technology component in their evaluation processes (Wetzel et al., 2001). If a teacher is not using or not provided with technology, then the school may allow the teacher to collaborate with his or her peers or attend seminars to learn (Miranda & Russell, 2011; Socal, n.d.). As Koch and Burghardt (2002) state, utilizing technology should no longer be an option, and we should explore the types of teachers making greater use of technology in the classroom to have a better understanding of where we should focus in regard to teaching and technology.

Americans are surrounded by technology: children in elementary school have cell phones and iPads; 750,000,000 people are members of the social network Facebook; the social network Twitter has 500,000,000 users; and the video posting site YouTube gets over 400 billion views per day (King, 2011; McMillan, 2011). Many people have

smartphones, which provide instant access to the Internet and to e-mail. Waiting in doctors' offices or standing in line at the grocery store is now more bearable because people are able to surf the Web or play games on their phones while they wait. Technology is present in many people's daily lives, which means that classrooms should also embrace this view of technology. If the education system is preparing children to be independent thinkers in the "real world," then technology should be employed by teachers and schools as part of students' everyday lives.

Finally, the use of technology should be explored because it constantly grows and changes—it is difficult to stay up-to-date with the newest technology. Teachers can become comfortable with a certain technological device when it may be quickly replaced with something newer and better. Simply placing a child in front of a computer to play multiplication games is not enough to claim that technology is being used. It is also not enough for the only user of technological devices in the classroom to be the teacher in direct instruction. As Curtis (2003) stated, technology must be put into the students' hands, and the students must be allowed to explore these devices and to learn how to use technology to produce quality projects.

Statement of the Problem

The current study investigates the extent to which students are perceived to be acquiring the technological skills they need to be successful in the 21st century. This includes skills in creativity and innovation, critical thinking, problem-solving, research and information fluency, written and verbal communication, and collaboration. These skills have been important for many years and continue to be at the forefront in college and in the workforce. This current study will also examine the ways teachers use

technology. The study seeks to identify if there is a significant difference in teachers' use of technology across the range of grade levels, years of teaching experience, age, and levels of education.

Research Questions

The primary purpose of the current study is to examine the use of technology among teachers to determine if they are using technology and teaching the skills necessary to prepare their students to be successful in the 21st century. These research questions that will aid in discovering this purpose are:

1. To what extent does the frequency of teachers' use of technology differ by grade level taught, years of teaching experience, gender, age, and level of education?

2. To what extent does the teachers' self-assessed level of technology integration differ by grade level taught, years of teaching experience, gender, age, and level of education?

3. To what extent do teachers' perceptions of the classroom impacts of technology use and integration differ by grade level taught, years of teaching experience, gender, age, and level of education?

4. To what extent are students' acquisition of skills in creativity and innovation, critical thinking, problem-solving, research and information fluency, written and verbal communication, and collaboration related to teacher's frequency of technology usage?

5. To what extent are students' acquisition of skills in creativity and innovation, critical thinking, problem-solving, research and information fluency, written and verbal communication, and collaboration related to teacher's self-assessed level of technology integration?

6. To what extent are student acquisition of skills in creativity and innovation, critical thinking, problem-solving, research and information fluency, written and verbal communication, and collaboration related to teachers' perceptions of the classroom impacts of technology use and integration?

Significance of the Study

The current study is significant primarily because technology is now pervasive in schools in the 21st century and continuously advancing. Schools should be fostering students' technological skills in their curriculum while simultaneously providing students with the skills they will need to compete in the 21st century. In this study, teachers were surveyed to determine if they use technology in their classrooms and the extent to which they do. The study is specifically designed to identify if there is a significant difference among teachers who teach different grade levels, vary in years of experience, ages, and levels of education. This information could be useful to both teachers and administrators in terms of planning professional development activities. In addition, the results of the current study could positively impact the hiring of new faculty members. Another reason this study is significant is that it will show how well students are being prepared for the 21st century, as learning 21st century skills will allow students to be independent learners who can also collaborate with their peers. It is the common benefit of all those involved in education to know the skills that are being taught and those that are not.

Limitations of the Study

As with any study, the current inquiry is not void of limitations. One limitation is that the results of the study could not be generalizable to the larger population of public school teachers. A second limitation of the current study is the sample size. Finally, the

study could be limited if the teacher participants answered the survey questions in a biased manner. In addition, it is worth mentioning that (1) All of the teacher participants were public school teachers; (2) All of the teacher participants were from one school district; and (3) The sample size is small, as it consists of teachers from eight elementary schools, three middle schools, and only one high school.

Definition of Terms

The following terms will be used throughout the current examination of the ways in which teachers are using technology in their classrooms to provide students with the skills they need to succeed in the 21st century:

Technology: Refers to computers or computer-related devices or capabilities, such as wireless internet, LCD projectors, document cameras, interactive whiteboards, laptops, net book computers, smartphones, electronic readers, student response systems, video or voice recording mechanisms, desktop computers, television monitors, VCRs or DVD players, and digital cameras.

21st century skills: Refers to the skills of creativity and innovation, critical thinking, problem-solving, research and information fluency, written and verbal communication, and collaboration (Jacobs, 2010; Trilling & Fadel, 2009).

Organization of the Study

This study is divided into four chapters. Chapter 1 provides an introduction to the study and also addresses its relevance. This chapter includes a problem statement, the research questions guiding the inquiry, a statement of purpose, the significance of the study, limitations and delimitations of the study, and several terms and definitions that will be used throughout the study of terms. A review of related literature is also included

in this chapter. In the first section of the literature review, the essential "21st century skills" that students should be taught in school to ensure some level of future success will be identified and thoroughly discussed. These skills are creativity and innovation, solving problems, critical thinking, research and information fluency, digital citizenship, and written and verbal communication and collaboration. The evolution of technology up to 2013 is also covered in the literature review. Next is a discussion of the technology used in today's classrooms, and this is followed by a discussion of existing literature related to technology in education.

Chapter 2 describes the methodology used in the current investigation. This chapter begins with a discussion of the research design used to administer and interpret the results of a survey. The study's participants and the survey instrument used are described in detail. Chapter 2 also delineates the data analysis method using ANOVA and correlation.

The findings of the study are presented in Chapter 3. First, I discuss descriptive statistics as they pertain to the participants. Next, each subject matter domain is explained and accompanied by a table. Each research question is identified in this chapter as well, and statistical findings and tables are included. Finally, the study's findings are summarized in this chapter.

Chapter 4 includes the discussion, recommendations, and conclusion. The chapter begins with a discussion of each of the major findings. Recommendations for policy and practice are identified next, and there are also recommendations for future research. Finally, there is a conclusion in which the importance of the 21st century skills and technology are described.

Review of Literature

Identifying the Essential 21st Century Skills

"If we teach today's students as we taught yesterday's, we rob them of tomorrow" (Dewey, 1944, p. 167). As Jacobs (2011) discusses, over 10% of the 21st century has already passed, yet many teachers are still not aware of the skills their students need to be successful in today's workforce and in the greater society. Oftentimes, teachers know what these skills are, yet they are reluctant to incorporate use of these skills into their classrooms for various reasons, such as testing demands, the lack of time, or a lack of resources. Jacobs (2011) deems that most schools of today still follow the traditional structure of schools past. For example, most textbooks are focused on curriculum developed in the 1980s. However, students are expected to thrive outside of the school and compete for jobs in the 21st century (Jacobs, 2011). "As educators, our challenge is to match the needs of our learners to a world that is changing with great rapidity" (Jacobs, 2011, p. 7).

Many scholars have attempted to define the skills that teachers should be teaching in the 21st century. Trilling and Fadel (2009) identify three broad skills as 21st century skills: "learning and innovation skills, digital literacy skills, and career and life skills" (p. viii). According to Trilling and Fadel, learning and innovation skills include "critical thinking and problem solving, communication and collaboration, and creativity and innovation" (p. 49); the digital literacy skills are "information literacy, media literacy, and information and communication technology" (p. 65); and life and career skills encompass "flexibility and adaptability, initiative and self-direction, social and cross-cultural interaction, productivity and accountability, and leadership and responsibility"

(p. 74). Trilling and Fadel assume that these are the types of skills that educators have always attempted to teach. However, these skills looked different in the Agrarian Age when the primary job was farming, in the Industrial Age when most men were in the business of trading and working in factories, and now in the Knowledge Age while technology is flourishing (Trilling & Fadel, 2009). "Using knowledge as it is being learned—applying skills like critical thinking, problem solving, and creativity to the content knowledge—increases motivation and improves learning outcomes" (Trilling & Fadel, 2009, p. 50).

The Partnership for 21st Century Skills (P21), founded in 2002, is a foundation that seeks balance between the core subjects (i.e., reading, writing, mathematics, foreign languages, social studies, science, the arts) and 21st century skills. According to P21, these skills are critical thinking and problem solving, communication, collaboration, and creativity and innovation. The primary focus of this group is to ensure that students are given real-world situations that will allow them to function in the world that exists outside of the school environment (Framework for 21st Century, 2011).

Another model of 21st century skills was created by the Assessment and Teaching of 21st Century Skills (ACT21S) group. The ACT21S group developed four categories of skills: (1) ways of thinking, (2) ways of working, (3) tools for working, and (4) skills for living in the world. The "ways of thinking" category includes the skills of creativity, critical thinking, problem-solving, decision-making, and learning. Communication and collaboration can be categorized into the group of "ways of working." The "tools for working" category includes information and communications technology and information literacy. Finally, the "skills for living in the world" include citizenship, life and career,

and personal and social responsibility. At the heart of the ACT21S group is the goal of ensuring that children are being prepared for the digital age and for their futures (*Purpose*, 2013).

The Center for Public Education (2009) categorized the most important skills for the 21st century into three groups. The first group contains traditional academic knowledge and skills, as these basic academic skills should not be overlooked because of testing requirements, the use of technology, or any other factors. The second category is real-world application, in which students should be able to apply school knowledge so that it benefits them outside of school. For instance, students learn in school how to add and subtract decimals, so when they go into a grocery store, they should be able to apply those skills to determine food costs prior to checking out, making sure they have enough money or being sure they are paying the correct amount. The final category refers to broader competencies, including interpersonal relationships, problem-solving, creativity, flexibility, and independence. These types of skills are usually not included in the written curriculum, but they are part of what is known as "hidden curriculum" (Jerald, 2009).

Each of the aforementioned organizations recognizes the need to incorporate new skills in the classroom while still prioritizing students' academic success. Despite which model is used to identify 21st century skills, there are 6 basic components always present, which are (1) creativity and innovation, (2) critical thinking, (3) problem solving, (4) research and information fluency, (5) digital citizenship, and (6) written and verbal communication and collaboration.

Skills category 1: Creativity and innovation. Creativity can be defined as "purposeful and involved effort to make something work, to make something better, more

meaningful, or more beautiful" (Starko, 2005, p. 7). Thorne (2007) says that "all have the capacity to be creative" (p. 42). However, people can be creative in different areas (e.g., fine arts, literature, inventions) and can exhibit it in different ways, such as being an artist, a musician, or an architect (Davis & Scott, 1971). The school setting can be critical in the process of being creative (Gowan, Demos, & Torrance, 1967), and creativity is actually a skill that can be taught to children. Students must be taught when to apply creativity and the context in which it should be used (Nettelbeck, 2005). Some students are naturally more creative than other students. Sometimes in the school setting, creativity can be received as a student "asking too many questions" or "not following the teacher's instructions" precisely. Despite a student's extent of creativity, teachers can foster their students' creativity and even teach creativity to those students who do not exhibit it (Gowan et al., 1967; Thorne, 2007). Teachers can create a classroom where students are free to share new ideas. Encouraging students to think about different outcomes will allow an environment that helps manage creativity (Norman, 2006; Thorne, 2007).

"Innovations are ideas successfully applied," according to Dodgson (2007, p. 13). Innovation is mostly used by organizations and businesses to create new products or to advance an existing product (Dodgson, 2007). Creativity and innovation can be seen as different elements; "however, there would be no innovation if creative ideas were not generated in the first place" (Thorne, 2007, p. 9).

Both creativity and innovation can be promoted in the classroom via various models, for example, the 3-part "incubation model" (Torrance & Safter, 1990). In the first stage of this model, learners are engaged through warm-up activities, and the

students can use their prior knowledge or an activity can build upon the students' interests. The second stage of this model is known as "deepening expectations" (Starko, 2005, p. 181). As Starko suggests, "This stage requires learners to process new information and address the puzzling situation raised in stage one" (p. 181). This can be done by the students studying a new topic, looking at previous data and the way it applies to new data, or predicting what could happen based on evidence. The third stage of this model consists of the students using the information gathered in the second stage to produce a culminating product. The incubation model is interesting to students, allows them to discover information, and implies that there are multiple ways to be creative (Starko, 2005).

Wallas (as cited in Thorne, 2007) developed another model used to describe creativity in 1926. The first stage in his model is preparation, which is simply gathering data or thinking about a research question. The next stage is incubation, which refers to the initiation of ideas. Illumination is the third stage, which is when one searches for an answer and discovers it. The final stage is verification, in which one shares his idea "to make sure that it really is worth investing time and resources to take it forward to the next stage" (Thorne, 2007, p. 44). Thorne identified another stage that should be included, execution. Execution refers to a plan being put into action (Thorne, 2007).

All of these models provide teachers with ways to trigger students' creativity, and many different strategies can be implemented through these models. Divergent thinking strategies are ways to increase creativity in the classroom. Starko (2005) teaches her students, "Your first idea is practically never your best idea" (p. 191). Gowan et al. (1967) state that when students have an answer, they can craft a list of more ideas, which

allows them to think of better ways to solve a problem. Teachers must present a problem or issue that sparks their students' creativity, not merely ask a question that has one right answer (Starko, 2005).

Another strategy that teachers can use to inspire creativity is brainstorming and broadening one's knowledge. This can be used when someone is attempting to solve a problem or wants to generate new ideas related to a particular topic. Students must feel as if no answers are "wrong answers" to generate as many answers as possible (Davis & Scott, 1971; Thorne, 2007; Torrance, 1970). Visualization can also be used to enable students to explore the different ways they can respond to a problem. This method involves the use of boards and graphics so students can actually "see" alternate ways to do something. People who read and play music are often more creative than those that do not. Therefore, teaching children to sing, hum, whistle, or play an instrument can be rewarding in encouraging creativity.

Another activity that encourages creativity is illustrative journaling, which refers to students telling a story by drawing in their journals. Despite the strategy teachers use to promote creativity, they must remember that everyone learns differently and that those differences must be taken into account (Poole, 1979; Thorne, 2007). Thorne (2007) adds, "If we create generations of young people unable to think for themselves, who are not excited about new ideas, who cannot undertake whole-brain thinking, there will be no innovation" (p. 8).

Skills category 2: Problem solving. The P21 group (2011) presumes that students should be able to "solve different kinds of nonfamiliar problems in both conventional and innovative ways and identify and ask significant questions that clarify

various points of view and lead to better solutions" (p. 1). There are two types of problem solving: (1) creative thinking (right side of the brain), which encompasses the formation of pictures and images and (2) scientific problem-solving (left side of the brain), which encompasses the use of numbers to think logically. Both forms of solving problems are important, and the best problem solvers actually use both creative thinking and scientific problem solving to find a resolution (Mackall, 2004).

Teachers can use outlines to practice solving problems. Mackall (2004) identifies one example as, "identify the problem, analyze the problem, research, brainstorm many options, think creatively, think logically, form a hypothesis, select the best option, negotiate possible pitfalls, and troubleshoot" (p. 10). The Socratic method is a form of solving problems that involves two or more people engaged in questioning and conversation until a difficult question is answered. As identified by Mackall, six types of questions can be answered using this method: "questions of clarification, questions that probe assumptions, questions that probe reasons and evidence, questions about viewpoints or perspectives, questions that probe implications and consequences, and questions about the question" (p. 29). Many of the people who already possess the skills needed to solve problems do not have to think about the six different types of questions when solving a difficult problem. However, students should be taught how to use both sides of their brains to encourage problem-solving outside the classroom (Nettelbeck, 2005).

Teachers can start with one of the outlines described and provide the students with strategies to assist them with solving problems. Brainstorming is one strategy students may use to help generate ideas. Asking questions is another strategy that can be

used in the classroom. When people question what is thought or seen, they can better understand and even challenge what they do not understand. Another strategy that can be used is "turning things upside down" (Mackall, 2004, p. 38), which refers to examining a problem from a different perspective than everyone else. In addition, teachers may require students to carry notebooks so that they can write down ideas whenever they think of them. Sometimes, ideas may strike when they are least expected, and carrying a notebook allows students to write down ideas to consider later (Mackall, 2004). Both children and adults are going to encounter real-world problems, and it is helpful to know how to deal with such problems before they are confronted with them (Jacobs, 2010).

Skills category 3: Critical thinking. Tittle (2011) says, "Critical thinking is judicious reasoning about what to believe and, therefore, what to do" (p. 4). This is also known as scientific problem-solving (Mackall, 2004). In the past, schools have been more focused on rote memorization. In this situation, there was more emphasis on acquiring "a lot" of information. However, the present focus is on actually applying the information to the things that are being taught (Trilling & Fadel, 2009).

Critical thinking is essential to independence and autonomous decision making whether or not an idea should be accepted. Critical thinkers are able to utilize their rationality as well as relevant evidence to make decisions or answer questions. Critical thinking skills can be applied to new situations instead of someone simply listening to others' opinions. Mackay and Jacobson (2008) discuss four steps to solving a problem that requires critical thinking: "identify the problem and break it down, collect information, form opinions, and draw conclusions" (p. 25). Overall, these skills can make

one a better citizen because he or she cannot only decide what is right, but can also find a solution (Tittle, 2011).

Critical thinking is not an inherited skill, but it is one that must be taught (Tittle, 2011). As Trilling and Fadel (2009), "These skills are developed most effectively through meaningful learning projects that are driven by engaging questions and problems" (p. 54). Teachers can create real-world problems to enhance these skills. For example, in 2003, six high school students from different places worked collaboratively on a project dealing with severe acute respiratory syndrome virus (SARS). These students collaborated using technology and created an educational website that other students could use. The students had to research the virus to gain more information about the virus, discovering things such as who obtains the virus, how to treat it, and how to prevent the spread of the disease. Part of the website's appeal was that games and vivid graphics were used to educate others on the virus and ways to avoid contracting it (Trilling & Fadel, 2009). Because of time zone issues and the intensity of the project, the students had to apply critical thinking skills throughout the project. The key to using project-based learning to enhance critical thinking skills is for the teacher to create a problem or question that cannot be answered using an online search engine. Students must perform a task that involves multiple steps and yields a project as the end result (Framework for 21st Century, 2001). Through programs and a rich learning environment, students are able to create, apply, remember, analyze, understand, and evaluate both inside and outside the classroom (Jacobs, 2010).

Skills category 4: Research and information fluency. Research and information fluency refers to students' ability to "...apply digital tools to gather, evaluate, and use

information" (Advancing Digital Age Learning, 2007, p. 1). Research skills using technology are becoming a necessity in many jobs and college courses, and being able to use technology properly can make these jobs and courses much easier. Even while home, people want to find information quickly that they can use to produce creative projects. A teacher's job is not to tell students exactly which buttons to press, but the teacher should facilitate the use of technology through the process (Jacobs, 2010).

There are many media-based tools that provide students with the means to apply, evaluate, and use information (McHaney, 2011). For example, instead of writing papers, students can create websites to display what they have learned, or teachers can produce games to have students demonstrate understanding. Audio and visual techniques can be created and applied to websites to entice viewers. In addition, people can post comments on these sites and also ask questions about the topic (Brooks, 1997; Trilling & Fadel, 2009). Teachers can also create videos, which enable them to share information with students in a different format than a test or paper. Students can gather the information and produce a play, create a cartoon, or find another innovative way to deliver the facts (Trilling & Fadel, 2009). Both of these methods can indicate if the students understand a concept, but in a creative way that is interesting for the participant and the viewer.

According to Advancing Digital Age Learning (2007), "Students need to locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media" (p. 1). Students graduating from high school should be able to perform these tasks. Because of the increase in the use of technology, teachers must be able to prepare the next generation to handle the large amount of "information, media, and technology" (Jacobs, 2010, p. 64).

Skills category 5: Digital citizenship. Digital citizenship refers to students being able to "understand human, cultural, and societal issues related to technology and practice legal and ethical behavior" (Advancing Digital Age Learning, 2007, p. 1). As part of the unwritten curriculum, teachers have an obligation to teach students the ethics of using technology, and students should know how to protect themselves when using social media. Students should also know how to respect other people's cultures and privacy (McKee & Porter, 2009).

When students are using the internet to conduct research, they should be able to differentiate between credible and non-credible websites. Therefore, students must understand that anyone can publish a website and also that a lot of the information found on the internet is false. Teachers should also educate students about biased information, as well as, ethical issues when doing research, since nearly every topic imaginable probably has some information on the internet. Although many inappropriate websites are blocked by school systems, teachers and parents should still teach students what is acceptable to view (McKee & Porter, 2009). Students should also understand and obey copyright laws, since modern-day technology allows people to download and copy data with more ease than ever before. Students should be taught the importance of paying for music and getting permission to use graphics (Spier, 2002).

Today, many people use social media sites to keep up with friends and family and also express themselves; nevertheless, social media can present special problems. Students should understand how to adjust their privacy settings so that they know who is viewing their personal information. Children should also understand the risks associated with communicating with strangers. According to McKee and Porter (2009), posting

inappropriate comments and materials on social media sites can have a negative effect on students. Similarly, students should respect others' privacy. As Spier (2002) mentions, students should not search for information about someone else just because the information is available, nor should they attempt to use someone's personal information in a harmful manner (Spier, 2002).

Not only should students learn the ethics of using technology, but they should also learn to develop positive attitudes that will foster lifelong learning and collaboration through technology (Morrison & Lowther, 2010). If a classroom is filled with technology that students are not allowed to use, then the students might be apprehensive when they are given the chance to use it. Students should not be afraid to make mistakes or push the wrong button. With proper guidance and reasonable rules, technology should be an adventure for children to discover hidden talents and to spark creativity (Jacobs, 2010).

Skills category 6: Written and verbal communication and collaboration. Written and verbal communication and collaboration skills have always been present in the curriculum; however, as technology advances, communication and collaboration are necessary in different ways. Because of digital tools, such as video conferencing, Skype, and FaceTime, individuals can have meetings and discuss important matters with their counterparts in remote locations. In addition, meetings can happen more regularly because no money is spent on travel (Trilling & Fadel, 2009). In many workplaces, the staff must be able to communicate ideas and suggestions clearly and in a manner that will not offend other staff members. People must be able to collaborate to solve problems, offer suggestions, or to simply converse during break times. Therefore, students should practice communicating their ideas in a reasonable manner (Jacobs, 2010).

Communication can be taught in various creative ways using modern technology. Web logs (blogs) and wikis are vehicles that can be used to develop communication skills that can reach the school, the community, and beyond. Teachers can develop these as well as other Web 2.0 resources to engage their students. For example, students might respond to a question the teacher posts via blog that requires critical thinking (Mackey & Jacobson, 2008). The students can later read each other's responses, comment to agree or disagree, and support their responses. Also, if a teacher goes on vacation, he or she may keep a daily blog or post pictures for the students to see; a student could do the same (Jacobs, 2010; Trilling & Fadel, 2009). Likewise, teachers should give students the opportunity to collaborate in the classroom. Most students enjoy activities more if they are allowed to work with their peers, and the teacher has a chance to correct inappropriate behavior, easing successful collaboration in the future (Hoyle, English, & Steffy, 1998; Trilling & Fadel, 2009).

Some infer that communication via technological devices can negatively affect a person's writing. Text messaging (sending written messages from one phone to another) and instant messaging (sending written messages via computer) have inspired many shortened forms of words, phrases, and sentences. This has lowered students' standards of writing in complete sentences and using correct grammar (McHaney, 2011). Others think that messaging using technology should not matter because teachers can still teach students the proper way to write (Pachler, Bachmair, & Cook, 2010).

Factors to Establish 21st Century Skills

Several researchers have argued that 21st century skills can be accomplished by making changes to the existing education system (Jacobs, 2010; Rose & Meyer, 2002;

Trilling & Fadel, 2009). Jacobs (2010) and others (Rose & Meyer, 2002; Trilling & Fadel, 2009) discuss factors such as scheduling, space, and assessments that could sway teachers and students away from the norm to foster these necessary skills. Scheduling can be seen as a problem in the United States because schools can be highly structured. Some students are academically ready to move to the next level but must wait because of the controlled academic term. Other students are unable to learn in pace with the academic year, so they may be retained in a grade and possibly even drop out of school (Jacobs, 2010). Further, many schools set aside a specific time to teach each subject. The school schedule should be flexible so that teachers have opportunities to explore, question, and make discoveries (Trilling & Fadel, 2009).

> A professional instructional schedule that would give adult professionals the opportunity to envision the learning experiences first and then match them with the time configurations available within the limits or possibilities of the school. This approach also suggests that sometimes learning does not have to be structured in the school space but can be handled in virtual space. (Jacobs, 2010, p. 66)

The space in which students learn, when it is a self-contained classroom, can be considered a dilemma to teaching 21st century skills. In many schools, students in the earlier grades stay in one classroom with one teacher during the school day while the students in upper grades rotate from classroom to classroom. Yet, neither might be the best atmosphere for learners. Students should be able to explore and discover outside of the walls of a building (Jacobs, 2010). As Trilling and Fadel (2009) point out, sufficient space should be available for students to complete projects and give presentations. Although teachers cannot do much about classroom conditions, it is still necessary to venture into other areas of the school to change the scenery for students (Jacobs, 2010)—being seated all day can have a negative effect on learning for some students.

All of the 21st century skills are important to teach in classrooms. Since these skills can be abstract and are not measureable with fill-in-the-blank tests, other evaluation methods should be used to ensure that students are reaching the goals associated with learning each of these skills. Rubrics, which are checklists that allow points based on accomplishments, can be used to score projects, presentations, and observations. Some teachers provide students with these rubrics before assignments are completed so that students know the expectations of the assignment. Other teachers outline assignment requirements when they give directions (Trilling & Fadel, 2009).

Jacobs (2010) acknowledges the digital portfolio as another helpful student assessment tool. A digital portfolio is a compilation of a student's work throughout the year in electronic format. These can be prepared in various ways depending on the grade level and the teacher's goal. The digital portfolio can show a student's mastery of certain skills and the student's progress throughout the year. Upper-level students might prepare papers or videos to show their progress and later compile these materials in a folder on a computer or a portable storage device. Lower-level students might scan their math problems or handwriting to their computers to keep in their portfolios (Jacobs, 2010).

The world is constantly changing, so it is essential that education changes as well for students to thrive and stay connected (Rose & Meyer, 2002). A student's mastery of 21st century skills does not guarantee their success after high school, but it is a step in the right direction. Teaching these skills using meaningful, real-life activities will allow students to apply their knowledge when challenges occur in their lives outside of the school setting (Trilling & Fadel, 2009).

One way teachers can employ the 21st century skills is through the use of technology, which can be used to aid the teacher when teaching a concept but should not be the primary focus during a lesson. Technology is helpful when a teacher wants to integrate more than one subject (Broderick, 1968). As Grabe and Grabe (1996) mention, it is useful to understand the evolution of technology and the types of technological devices that can be used in education.

The Evolution of Technology in Education

Since the 18th century, technology has evolved in assisting educators in the classroom (Anglin, 1995; Dunn, 2011; Saettler, 1990). Saettler (1990) states:

> Educational technology, as a process, emerged out of the early technological tradition when a kind of knowledge began to be systematically applied to instruction. Educational technology, despite the uncertainty of the origin of the term, can be traced back to the time when tribal priests systematized bodies of knowledge and early cultures invented pictographs or sign writing to record and transmit information. In every age, one can find an instructional technique or a set of procedures intended to implement a particular culture. The more advanced the culture, the more complex became the technology of instruction designed to reflect particular ways of thinking, acting, speaking or feeling. Over the centuries, each significant shift in educational values, goals or objectives has led to diverse technologies of instruction. (p. 4)

Educational film, radio, projectors, and mimeographs. Saettler (1990) considers the educational films from 1910 the first technological invention in education. George Klein proposed the film to a New York school system, but the equipment was too expensive. Later, the public school system in Rochester, New York, was able to afford the equipment. Shortly thereafter, film companies began to find ways to manufacture the equipment more cheaply so that other school systems could afford to put them into the schools (Saettler, 1990). In addition, from 1925 to 1935, the use of the radio was effective (Dunn, 2011). Radio stations would replay lectures from professors; they would

also broadcast poems, riddles, current events, short stories, and music from other countries as well as air discussions about geography and health (Saettler, 1990). The overhead projector, which was first seen in schools in 1930, was also a device that had an impact. The overhead projector allowed teachers to use a clear sheet-like film to make an magnify an image and display it on a wall or board so that so that everyone in the room could view the image at the same time (Dunn, 2011). In 1940, another useful invention called the mimeograph impacted the classroom. The mimeograph allowed teachers to make copies of paper by cranking a handle for each copy (Saettler, 1990).

Headphones and computer-assisted instruction. The years 1950 to 1980 were the years of the Information Society, which refers to the time when communication became more important to Americans and in education (Betrus & Molenda, 2002). The year 1950 was also when headphones, which enabled each student to receive personal instruction, were introduced to schools. For example, students could read along with books on tapes or listen to lectures on performing long division using headphones. Computer-assisted instruction was also prevalent in schools in the 1950s. Computer-assisted instruction referred to lessons created by teachers in which they used digital computers to teach their lessons (Gagne, 1987; Hicks & Hunda, 1972). Hicks and Hunda (1972) assumed that "computer-assisted instruction will surely come into general use in the schools, probably within the next decade, and possibly before either the schools or manufacturers of computer-assisted systems can ensure its wise use" (p. 21).

Television and video. In the 1950s, the television and videotape were essential in classroom instruction. The first educational television network was developed in 1952 in Alabama, and the station covered various topics or attempted to aid the listeners'

understanding of a culture. This network led to the development of instructional television on commercial and educational stations (Saettler, 1990). Videotape recorders were used alongside televisions in the 1960s, giving teachers flexibility in the times in which they could allow their students to view certain programs (Gagne, 1987). In addition, programmed instruction made its first appearance in 1957 in Winchester, Massachusetts. In programmed instruction, a machine allows a user to read a question and then select an answer to the question. The machine could inform users if their answers were correct or incorrect. Some of the programmed instruction machines could tell the user why his or her answer was incorrect and provide additional instruction that would lead to the correct answer (Bork, 1981).

Photocopier and calculator. The photocopier, developed in 1959 by Gundlach and Carlson, replaced the mimeograph with electronic duplication of pages. A teacher could place the page they wanted to reproduce on the machine, press a button, and wait for the additional copies to printed. This was a more efficient and productive way to produce multiple copies of pages to circulate to students (Goodman, 2010). Another invention that improved education was the hand-held calculator introduced in 1970, which allowed mathematical operations to be completed by touching a set of buttons on a device. Teachers—both then and now—have concerns with the use of calculators, fearing that students will not understand how to do mathematical computations on their own (Dunn, 2011).

Computers. In the late 1960s, mainframe computers began a revolution in the field of education. These large, expensive computers could fill an entire room and were often housed in janitorial closets. To start a program, a teacher or student would go to the

closet, and the class could access the terminal, which looked like a large monitor and keyboard. On the terminals, students performed drill and practice tasks and watched lectures (Budoff, Thormann, & Gras, 1984; Evans-Andris, 1996; Jonassen, Howland, Marra, & Crismond, 2008). Education continued in the 1970s with microcomputers, also known as personal computers (PCs), and microprocessors (Riedesel & Clements, 1985). The Intel corporation developed the first microcomputer in 1971. Some schools adopted this PC; however, many continued to use the mainframe computer (Anglin, 1995). Four years later, Apple computers were donated to many schools (Evans-Andris, 1996). However, it was 1980 when the TI 99, which was also a PC, became most popular in education (Lewis, 2000). With the development of microcomputers came the affordability of these machines, and they were small enough to be placed on a table. To this day, most computers are considered microcomputers (Bork, 1981). Saettler (1990) asserts, "The critical aspect of the information society is increasing digitalization of mass media and telecommunications content" (p. 395). This allows humans and machines to interact interchangeably to create benefits for the educational system (Saettler, 1990).

The Information Age: Computer technology, CDs, and teleconference. The 1980s and 1990s are known as the Information Age because technology production began increasing at a rapid pace (Saettler, 1990). Microcomputers continued to flourish, with IBM making a noticeable advancement in 1981. IBM created microcomputers that were smaller and faster than other PCs (Evans-Andris, 1996). Additionally, interactive video emerged during this time, which allowed students to review lectures or concepts they may have missed. Interactive videos consisted of frames that used graphics and audio to create a video. Teleconferencing was also developed in this timeframe, which allowed

people to use two-way audio and visual feeds to communicate over long distances. Teleconferences were useful for question-and-answer sessions preceding a test, and they also allowed professors to deliver interactive lectures (Saettler, 1990). The use of compact discs (CDs) came around 1985 with the invention of the CD-ROM drive. Describing CDs, Dunn (2011) stated that "A CD could store an entire encyclopedia plus video and audio" (p. 16). Later in 1985 came the graphing calculator, which dramatically changed mathematics education. These calculators allowed students do more than simple computations—they could compute algebra equations and graph points and lines (Oldknow, 2011).

Personal computer and whiteboard. Apple II and Macintosh computers gained popularity in elementary schools in 1986 (Evans-Andris, 1996). Provenzo (1996) found that 25% of high schools used PCs by this time. In addition, Betrus and Molenda (2002) recognized that nearly all students had access to a personal computer by 1995. Coinciding with personal computers in the school setting, teachers began to use interactive whiteboards in 1999. These boards allowed teachers and students to touch screens with a pointer, special pen, or their fingers to activate it; computer programs or projector images could be displayed on-screen (Dunn, 2011). All of these inventions paved the way for today's technological achievements.

Technology in Today's Classrooms

The 21st century has already brought the most exhilarating technology to date (Mishra et al., 2012). Morrison and Lowther (2010) identified four categories of technological tools used in classrooms today's classrooms: computers, mobile devices, data storage, and peripherals. Gray et al. (2010) found that 98% of teachers have more

than one computer in their classrooms. Most schools have either desktop computer (that stay in one place) or laptop computers (that can be moved around). Some desktops have different components for the mouse, keyboard, monitor, and central processing unit while newer desktops have monitors and central processing units in the same device. These computers can have either wired or wireless connections to the internet while most laptop computers are wireless (Provenzo, 1996). Both types of computers can be equipped with audio/speakers, microphones, cameras, CD/DVD readers, CD/DVD burners, and "many connections for an external monitor/display, USB, and Firewire, and audio and video inputs and outputs" (Morrison & Lowther, 2010, p. 66). Computers allow teachers and students to perform educational tasks using internet sites, CDs, and educational software. Students can also play or create games and simulations on the internet (Jonassen, Peck, & Wilson, 1999). Despite the topic, when a teacher spends time planning a meaningful lesson using a computer, more students will be interested and involved (Starr, 2011).

Hand-held mobile devices allow users to perform many tasks, such as sending and receiving electronic messages, browsing the web, listening to music, and reading books (Morrison & Lowther, 2010; Pachler, Bachmair, & Cook, 2010). Electronic book (e-book) readers are digital devices that resemble books. At the push of a button, people can turn pages and can also choose from different books (Morrison & Lowther, 2010). Some schools allow students to store textbooks on electronic readers instead of purchasing multiple textbooks (Pilgrim et al., 2012). Digital cameras and video cameras are also present in 93% of schools in the United States (Nagel, 2010). With digital cameras, only the desired pictures must be printed. With video cameras, students can produce their own videos or film lectures that they can watch at home. Global positioning systems, also

known as GPS, are systems that can show a person exactly where he or she is and also give directions to get to other locations through the use of latitude and longitude. Teachers can plan activities for their students to use coordinates to find a specific location. Students can also learn about their schools, cities, and local historic sites using GPS technology (Morrison & Lowther, 2010). Another mobile device is the personal response system, which is now in 38% of public schools (Nagel, 2010). This system allows students to click a button and get immediate answers to a question. It also enables a teacher to quickly see if students understand the concepts or skills being taught. The personal response system provides teachers with immediate results, thereby reducing the amount of time it takes to grade (Rubenstein, 2011).

Cellular phones are also being used as learning tools in some high school classrooms. Lenhart, Ling, Campbell, and Purcell (2010) attribute this to the fact that 75% of teenagers own cell phones. Pachler, Bachmair, and Cook (2010) declare that many teachers find cell phones a distraction and are banning them from classrooms while other teachers are incorporating cell phones into their daily lessons. For example, a high school teacher may use a cell phones as a personal response system, having the students text them answers. Other teachers are allowing students to use the internet for research purposes during class time. Teachers are also using phone cameras, which are a part of most cell phones. Students can go on scavenger hunts and take pictures of objects they find, or students can create videos on their phones to use for presentations (Engel & Green, 2011). Morrison and Lowther (2010) presume that digital media players (e.g., iPods, Zunes, Fuses) and recorders have an impact in the classroom. These music players allow teachers to transfer audio and video files to students so that they better understand a

concept. Using music players, students can listen to someone read a book or listen to a poem in Old English or maybe watch someone perform a science experiment. With recorders, students can record a lecture or record their own voices for purposes of studying or becoming a better reader (Morrison & Lowther, 2010).

The personal data assistant, also called the PDA, is another device being used in upper grades. A PDA fits into a person's hand and perform much like a computer. According to Morrison and Lowther (2010), "Basic functions include an interactive appointment calendar that sounds an alert for upcoming meetings, address book, calculator, memo pad that often converts handwritten notes into text, and a task list" (p. 72). Other devices similar to the PDA are the iPad, the iPad mini, and a several other tablets. The iPad first appeared in 2010, and Pilgrim et al. (2012) expect that this tablet-like computer will revolutionize education. It "is a small, hand-held computer with a flat touch-screen that serves as a personal computer with wireless access to the Internet" (Pilgrim et al., 2012, p. 17). With modern technology such as this, students can use tablets just as they use textbooks by highlighting, underlining, or taking notes using their fingers or a stylus (Pilgrim et al., 2012).

Teachers can use applications, which are pieces of software that can be used on a phone, computer, or on the internet, to teach concepts in an exciting way (Murray & Olcese, 2011). Likewise, digital gaming, which consists of hand-held games, computer games, or game consoles, is being utilized in some classrooms. Klopfer, Osterweil, Groff, and Haas (2009) some of the benefits students get from playing games, stating that it helps them with their lives when solving problems or searching for ways to achieve goals. Although there are rules that must be followed, children are still having fun. On

average, boys spend 23 hours per week playing video games while girls spend 12 hours. This familiarizes many children with the language and dialect they need to be successful while playing these types of games both during and outside of school (Klopfer et al., 2009). It may take the teachers some time to become familiar with games; however, the outcomes of learning about gaming can have a positive impact on students (Morrison & Lowther, 2010).

A peripheral is a device that can be attached to a computer although it is not necessary for basic computer functioning (Morrison & Lowther, 2010). One example is the microphone, which allows teachers and students to record their voices and broadcast activities on the web. Headphones are useful peripherals in the classroom because they allow students to listen to the audio from the computer without disturbing the entire class (Grabe & Grabe, 1996). There are also speakers, which can amplify a computer's sound so that the entire class can hear (McHaney, 2011). According to Gray et al. (2009), 73% of schools have interactive whiteboards, another type of peripheral device. The interactive whiteboard allows users to touch the board to manipulate a projected image. Teachers and students can work on math problems or writing or even browse the web using the whiteboard technology (McHaney, 2011; Morrison & Lowther, 2010).

Many classrooms have access to either an inkjet or a laser printer. Teachers may use a printer to print lesson plans, worksheets, or other necessary documents; students may need printers to print typed stories, pictures for a projects, or notes from presentations (Morrison & Lowther, 2010). In addition, Gray et al. (2009) reported that 97% of public school teachers have projectors in their classrooms. Projectors provide a larger display of an image from a computer, document camera, or DVD/VHS player on a

flat surface (e.g., wall or whiteboard). Another device used in conjunction with a projector is the document camera, which is a digital camera that is connected to a stand that teachers can use to hold an image that they want to display via the projector. As Doe (2008) states, document cameras allow students to look at papers being corrected, view diagrams, or perform mathematical problems in front of the entire class (Doe, 2008). There is also the webcam, which is a small video camera that is either built into a computer or can be plugged in. Students can have live conversations with pen pals in other countries or make videos using webcams (Sawyer, Butler, & Curtis, 2010). Once a teacher becomes familiar with peripheral devices, these devices can be used to engage the entire group of students (Morrison & Lowther, 2010).

Portable data storage devices can also be useful to teachers and students. Teachers can save lesson plans, activities and worksheets, letters, or other typed work, and students may need to save work they produce for a class. A teacher may want to make a portfolio concluding the academic term or maybe save their students' work to show to other classes. External hard drives, flash drives, and storage cards are all examples of portable data storage devices (McHaney, 2011; Morrison & Lowther, 2010; Provenzo, 1996). External hard drives are used to store large amounts of data. They are small rectangular boxes that usually plug into the motherboard or USB port of a computer (Morrison & Lowther, 2010), and they can store anywhere between 160 GB to 16 TB of memory (Gygabytes, 2011). A flash drive is a smaller storage unit that is plugged into the USB port. Flash drives are typically about 1/2" wide and 2" long and can be carried in multiple ways, such as around the neck, on a keychain, or in a purse, pocket, or bag. A storage card, which is about an inch long and an inch wide, is used to transfer data from a device

(e.g., camera, video camera, music player) to a computer, allowing the user to print pictures, edit videos, or listen to music that is has been saved to the storage card (McHaney, 2011). Aside from storage devices, there is also "cloud storage" in which data on a computer is saved to a third-party website via an internet connection. Once information is saved, a user can access this data from any computer or device connected to the internet. Most consumers presume that the storage capacity is limitless, and so far, this appears to be true (Strickland, 2013). Data storage essential to saving data or transferring data from one computer to another with ease (Morrison & Lowther, 2010).

Web 2.0 does not fit into the category of computers, mobile learning, peripherals, or data storage; rather, it uses these categories to promote social learning and communication (McHaney, 2011). McHaney (2011) further states:

> The term 2.0 doesn't refer to a technical update of underlying software and hardware but rather to changes in the way the Web is being used by business, universities, and society in general. Web 2.0 comprises five major, interrelated components: social computing, social media, content sharing, filtering/ recommendations, and Web applications. These components can be integrated into classroom pedagogy to provide richer knowledge delivery to the tech-savvy millennial. (p. 79)

Social computing is a way for people to communicate and socialize on the computer by talking and sharing videos, photographs, and other information. Facebook and MySpace are currently the most popular forms of social computing, where members creates a personal profile to display with pictures, interests, background information, and highlights of events from their lives (Aydin, 2012; Suhr, 2010). LinkedIn is another social network, but it is targeted toward professionals and businesses. Another form of web-based communication is instant messaging, where people can converse by typing messages to one another in real time (McHaney, 2011).

Online games also have an element of socializing because people from all over the world can compete. Participants can converse by typing messages or using microphones, thus minimizing distance barriers and cultural differences (Klopfer et al., 2009). Social computing can be integrated into school curriculum. One way is by teachers being available to students while they are at home to answer questions using instant messaging (McHaney, 2011). Using Facebook or MySpace, teachers can identify their students' interests students to make topics more meaningful (Aydin, 2012; Suhr, 2010). Organizations can also create Facebook pages to get people involved and to share ideas instead of having formal meetings (Aydin, 2012). Gaming can be used by teachers to help students learn certain strategies and skills. Overall, social computing gives teachers and students the freedom to be creative and stay connected after the school day ends (McHaney, 2011). According to McHaney (2011), "Social media promotes democratization of information and knowledge and allows students, teachers, and everyone else to become content producers rather than just consumers" (p. 100).

Web logging, or blogging, is another way for people to discuss certain topics or events, and people post their blogs on the internet for everyone to see or for only those they invite. Many teachers "blog" about their lives as teachers and some might blog about ideas and lessons. Classrooms can develop blogs to discuss certain concepts, as a teacher can pose a question and allow the students to reply with answers, which may begin a discussion of a topic (Doe, 2007). Wikis are more interactive blogs in which different people can comment on a post and share their insight. In a school setting, wikis can be used just as blogs are, except Wikis allow more conversation among more users (Doe, 2007). Podcasts are also a form of social media in which users can record audio files to

publish on online for other people to listen. With podcasts, a teacher can record lectures and a student can do various things, such as read a paper or make a radio commercial (McHaney, 2011).

The social network Twitter is a type of "microblogging," which allows people to instantly send updates about what they are doing and thinking (Schmierbach & Oeldorf-Hirsch, 2012). McHaney (2011) suggests that teachers can use microblogging to keep students informed of deadlines, or students could "follow" a business or an individual to obtain information. Social media allows teachers and students to engage in creative interactions inside and outside of school to make learning more relevant and interesting (McHaney, 2011).

There is a myriad of technological devices in today's classrooms, and this list is quickly changing; this rapid development makes it difficult for teachers to keep up with the latest trends. Pilgrim et al. (2010) theorize that the effort is what counts. Difficulty keeping up with new technology is not a reason for teachers to not try to use it (Morrison & Lowther, 2010). In addition, the existence of a new technological device does not mean that it is fit to be used for instructional purposes. The instructional design, not the newness, is what makes a device useful in the classroom (Saettler, 1990).

The Use of Technology in the Classroom

According to Miranda and Russell (2011), 97% of public schools have high speed internet connections. A study by the U. S. Department of Education (as cited in Gray et al., 2010) determined that 98% of elementary-level teachers have computers in their classrooms and 93% of those computers have internet access. In the same study, it was found that only 44% of teachers reported that they use technology often during

instruction. The Pew Internet Project Survey (as cited in Rainie & Hitlin, 2005) was focused on students' use of technology, establishing that 68% of teenagers use the internet at school. Also, Wetzel, Zambo, and Padgett (2001) found that teachers use their computers more during class time if they average five to seven computers in the classroom; it was also suggested that that there are money and space issues when dealing with five computers, but that these issues are manageable. The literature suggests that even with computers and internet in the classroom, teachers and students still may not use these devices for instructional purposes (Morrison & Lowther, 2010).

Other studies show that teachers are using many different types of technology in the classroom. Ojalvo (2010) posted a question on a blog asking children about the types of technology their teachers use in the classroom. The responses include clickers, computers, smart readers, microscopes, PowerPoint, Smart Boards, and projectors (Ojalvo, 2010). Bebell, Russell, and O'Dwyer (2004) concluded that teachers are moving from simple word processing to multimedia presentations and computer-based simulations as part of the instructional process. Liang, Huang, and Tsai (2011) found that teachers with interactive whiteboards use these boards for group instruction 72% of the day. According to Türel (2010), the interactive whiteboard should not be used only for lectures and to show images, but the students should be able to interact with the board when in small groups. Also, Lang (2009) documented that 91% of teachers have DVD players in their classroom, and 78% of those teachers use them on a regular basis.

Oliver, Osa, and Walker (2012) surveyed teachers from grades kindergarten to 12 to identify the types of instructional technology being used in the classroom. Their results showed that PowerPoint was the most used, with BlackBoard close behind. Teachers

reported use of video 50% of the time, digital cameras 38% of the time, and video cameras 31% of the time (Oliver et al., 2012). In a case study by Ng'ambi and Lombe (2012), podcasts were used in educational settings, in which the students listened to a relevant article or song and then made their own podcasts to present what they had learned (Ng'ambi & Lombe, 2012). Reinhart, Thomas, and Toriskie (2011) surveyed 94 teachers to determine how they used technology; findings suggested that 96% of teachers use the web, 88% use Web 2.0, and 21% use other gadgets (Reinhart et al., 2011).

Those who oppose the use of technology in the classroom presume that technology can be harmful to students and their futures. Rainie and Hitlin (2005) found that 37% of high school students said either they or their peers have cheated while using the internet for school assignments. Socol (n.d.) mentions that technology can be expensive and that many teachers lack the budgets needed to purchase the proper equipment. Although funding may be available, some teachers fail to take advantage of available grants or request funding from parent associations. Many classrooms today do not have working technology, so the hardware is only collecting dust, not benefitting the students (Norman, 1999). Additionally, some teachers are reluctant to adopt new technology if they think their more traditional methods are effective (Socol, n.d.). Kelly, Dockrell, and Galvin (2009), who studied students' posture during a computer class, found that 100% of the students reached a level of discomfort according to the "Body Discomfort Chart" when the 40 min. class session concluded. While it has been found that technology can have negative effects on users, the rewards and positive outcomes usually outweigh the negative effects (Jacobs, 2011). In conclusion, technology plays a vital role in the development of the 21st century skills. When a teacher supplements

lessons with technological devices and allows students to use these devices to explore class topics, the outcomes can stick with these students throughout their lives (Morrison & Lowther, 2010).

Chapter 2

Methodology

Research Design

The research design used in the current study included administering a survey (Appendix A) and interpreting the results. First, the Institutional Review Board at the University of Memphis accepted the IRB proposal (Appendix B) to perform the research. In this quantitative study, designed to show the impact of technology on student achievement, a questionnaire designed by Interstate Teacher Assessment and Support Consortium (InTASC) of the Council of Chief State School Officers and the Partnership for 21st Century Skills (P21) was completed. Teachers were surveyed in one school district to answer the following research questions:

1. To what extent does the frequency of teachers' use of technology differ by grade level taught, years of teaching experience, age, gender, and level of education?

2. To what extent do the teachers' self-assessed levels of technology integration differ by grade level taught, years of teaching experience, age, gender, and level of education?

3. To what extent do teachers' perceptions of the classroom impact of technology use and integration differ by grade level taught, years of teaching experience, age, gender, and level of education?

4. To what extent is students' acquisition of skills in creativity and innovation, critical thinking, problem-solving, research and information fluency, written and verbal communication, and collaboration related to teachers' frequency of technology usage?

5. To what extent is students' acquisition of skills in creativity and innovation, critical thinking, problem-solving, research and information fluency, written and verbal communication, and collaboration related to teachers' self-assessed levels of technology integration?

6. To what extent is students' acquisition of skills in creativity and innovation, critical thinking, problem-solving, research and information fluency, written and verbal communication, and collaboration related to teachers' perceptions of the classroom impacts of technology use and integration?

Development of the Survey Instrument

The survey used in the current study was developed by combining two existing questionnaires used by inTASC and the P21 organization. The first questionnaire was developed and used by inTASC in association with Boston College to explore the types of technology teachers were using and the frequency of use. Henry Braun, director of the survey, was asked via e-mail to grant permission to use the survey for the current inquiry research. He granted permission with the guarantee of the findings being shared with inTASC upon completion of the study (Appendix C). The survey contained 46 questions, but all of the questions were not needed for the study. Thus, the survey was shortened to include only demographic questions and questions related to the use of technology in the classroom.

The second questionnaire was developed by the P21 group and pertained to the 21st century skills and the influence of those skills in the classroom (Framework for 21st Century, 2011). Permission was given to use certain components of this survey via e-mail (Appendix D). This survey, which consisted of 23 questions, was also shortened for

the current inquiry, as the questions were selected that pertained only to the implementation of technology directly affecting the 21st century skills.

Since the two surveys that were used in this study have been used in other studies, their validity has already been established. The questions taken from each survey were retyped in Microsoft Word, and tables were created and adjusted the margins to make the survey more visually appealing. The Survey Monkey website was used to arrange the survey questions so that participants could complete the survey online.

The survey began with a consent form describing the nature of the study and giving the participants instructions. By clicking the "Next" button, participants agreed to participate. The screen that appeared at this point informed participants that their participation is voluntary and their answers are confidential. The teachers clicked "Agree" or "Next" advance to the next screen.

The questionnaire contained 14 individual items, with some items containing multiple parts. There were six demographic questions asked to identify the number of years teachers had been teaching, their genders and ages, the grade levels at which they currently teach, the subjects they are currently teaching, and the highest degree the teachers had earned. The next portion of the survey was related to how the teacher felt he or she was best integrating technology in the classroom using a 1 to 5 scale, with 5 being fully integrated into the classroom. The focus then shifted to 21st century skills and how well the teachers thought their students were acquiring each skill using a 1 to 5 scale, with 5 being fully acquired the skills. The value of technology integration on both the classroom and student achievement was emphasized in the next set of questions. The rating scale included strongly agree, agree, neutral, disagree, and strongly disagree. The

final section of the survey asked participant teachers to place a checkmark beside each technological device that they have and use in their classrooms. Teachers could check boxes for wireless internet access, LCD projector, document camera, interactive whiteboard, student computing devices, teacher computing devices, e-reading devices, student response systems, video or voice recording mechanism, TV monitor/VCR/DVD player, or a digital camera. If a teacher did not have the device, he or she indicated that it was not applicable.

Study Participants

The study included 275 public school teachers from a small school district in a city in the southern region of the United States with approximately 37,000 citizens. This was a convenience sample, meaning the schools were accessed with ease. The superintendent was contacted via telephone to gain permission to the school district. The goal of the research as well as the nature of the survey was explained thoroughly. After permission was granted, the superintendent designated the Director of Technology and Human Resources as the liaison. E-mails, telephone calls, and personal contact were implemented to plan the delivery of the surveys and ensure the teachers' cooperation.

There were 132 elementary school teachers from 8 schools surveyed, 62 middle school teachers from 3 schools surveyed, and 81 high school teachers from 1 school surveyed. Among the teachers that completed the survey, 103 were female and 21 were male. There were 31 teachers from grades kindergarten to second grade, 33 teachers from third grade to fifth grade, 31 teachers from grades 6 to 8, and 28 teachers from grades 9 to 12. There was also a variation in the number of years the teachers had been in the classroom; 2 had been teaching less than 1 year, 13 had been teaching between 1 and two

years, 12 had been teaching from 3 to 5 years, 32 had been teaching from 6 to 10 years, 31 had been teaching from 11 to 15 years, and 35 had been teaching for more than 15 years. The participant teachers also ranged in age; there were 29 teachers between the ages of 20 and 30 years, 30 between the ages of 31 and 40 years, 36 between the ages of 41 and 50 years, 28 between the ages of 51 and 60 years old, and 1 teacher that was older than 61 years.

Procedure

A letter (Appendix E) was sent via e-mail to the Director of Technology to provide more information about the researcher and the expectations related to the teachers taking the survey. The e-mail was forwarded to each principal in the school system. Next, the principals sent an e-mail to the teaching faculty; 70 participants responded. Another e-mail (Appendix F) was sent directly to the principals asking them to have the teachers complete the survey if they had not already done so. After the participants read the consent form and agreed to participate, they moved on to the survey, which was completed in approximately 10 minutes online.

Data Analysis

The data collected were analyzed using Statistical Package for the Social Sciences (SPSS) software. The research questions were evaluated using one-way Analysis of Variance (ANOVA), *t* tests, and the Pearson-Product Moment correlation. Teacher demographics and the 21st century skills were the independent variables, and the dependent variables were level of technology use, level of technology integration, and perceived level of impact on teaching and learning.

The first research question was, "To what extent does the frequency of teachers' use of technology differ by grade level taught, years of teaching experience, age, gender, and level of education?" Teacher characteristics used as independent variables were grade level taught, years of teaching experience, age, gender, and level of education. The dependent variable was the teachers' use of technology based on the frequency of each technological device queried on the survey. One-way ANOVA was performed to determine if there was a difference based on grade level taught, years of teaching experience, ages, and levels of education and the frequency of technology use by the teacher. An independent *t* test was conducted to explore if differences existed between gender and the frequency of technology use by the teacher.

The second research question was, "To what extent do teachers' self-assessed levels of technology integration differ by grade level taught, years of teaching experience, age, gender and level of education?" Teacher characteristics used as independent variables were grade level taught, years of teaching experience, age, gender, and level of education. The dependent variable was the teachers' technology integration. One-way ANOVA was performed to determine if there were a difference among the grade levels taught, years of teaching experience, ages, and levels of education and the integration of technology. An independent *t* test was conducted to explore if differences existed between gender and self-assessed levels of technology integration.

The third research question was, "To what extent do teachers' perceptions of the classroom impacts of technology use and integration differ by grade level taught, years of teaching experience, age, gender, and level of education?" Teacher characteristics used as independent variables were grade level taught, years of teaching experience, age, gender,

and level of education. The dependent variable was the teachers' perceptions of the classroom impacts of technology use and integration. One-way ANOVA was used to determine if there were a difference among the grade level taught, years of teaching experience, ages, and levels of education and the teachers' integration and use of technology. An independent *t* test was conducted to explore if differences existed between gender and the integration and use of technology.

The fourth research question was, "To what extent are student acquisition of skills in creativity and innovation, critical thinking, problem-solving, research and information fluency, written and verbal communication, and collaboration related to teachers' frequency of technology usage?" These 21st century skills were used as the independent variables while the dependent variable was the teachers' frequency in the use of technology. A correlation was used to determine if a connection existed between 21st century skills and a teacher's frequency of technology usage. In this correlation, each 21st century skill was examined individually to see if any of the skills directly affected any of the other skills.

The fifth research question was, "To what extent does students' acquisition of skills in creativity and innovation, critical thinking, problem-solving, research and information fluency, written and verbal communication, and collaboration relate to teachers' self-assessed level of technology integration?" The 21st century skills were the independent variables while the dependent variable was the teachers' self-assessed level of technology integration. Correlation was used to see if a connection existed between 21st century skills and the teachers' level of technology integration, with each 21st century skill examined individually.

The sixth research question was, “To what extent does students’ acquisition of skills in creativity and innovation, critical thinking, problem-solving, research and information fluency, written and verbal communication, and collaboration relate to teachers’ perceptions of the classroom impacts of technology use and integration?” The 21st century skills were the independent variables while the dependent variables were the teachers’ perceptions of the classroom impacts of technology use and integration. Correlation was used again to determine if any relationships existed among the skills and the perceived impact of technology use and integration on teaching and learning. Once again, each 21st century skill was examined individually.

Chapter 3

Findings

In the current study, 21st century skills and technology in the modern-day classroom were examined. The 21st century skills include creativity and innovation, critical thinking, problem-solving, research and information fluency, written and verbal communication, and collaboration. Technology refers to any computer or computer-related device used in the classroom. All teachers, from elementary to high school, working in a particular school system were asked to complete the survey. The content on the survey instrument was related to technology usage, technology integration, and the ways technology in the classroom impacts students obtaining necessary 21st century skills.

Demographic information is discussed in this chapter. Responses from the entire sample are presented in tables showing how teachers responded to the frequency of use of each technology surveyed, a self-report of the overall level of technology integration, the integration of 21st century skills, and the correlation between technology use, technology integration, and the impact on the classroom.

Descriptive Characteristics of Respondents

Participation in the survey was optional for the teachers in the 12 public schools included in the sample. Of the teachers responding, 23.7% (31) taught in grades kindergarten through second, 25.2% (33) taught in grades 3 through 5, 23.7% (31) taught in grades 6 through 8, and 21.4% (28) taught in grades 9 through 12. There were 15 (11.5%) teachers respondents that had been teaching for less than 2 years; 12 (9.2%) had been teaching for 3 to 5 years; thirty-two (24.4%) teachers had been teaching for 6 to 10

years; thirty-one (23.7%) teachers had been teaching for 11 to 15 years; and thirty-five (26.7%) teachers had been teaching for more than 15 years, which is the largest percentage of the sample.

Other demographic factors included age, level of education, and gender. In terms of age, 22.1% (29) were 20 to 30 years of age, 22.9% (30) were 31 to 40 years of age, 27.5% (36) were 41 to 50 years of age, and 22.2% (29) were 51 years of age or older. Forty teachers had completed bachelors' degrees, and 84 (64.1%) had received a master's degree or higher. In addition, 21 (16%) male teachers and 103 (78.6%) female teachers participated in the study. Because the sample was not well balanced, gender could not be explored during data analysis.

Table 1 provides a complete summary of the demographic characteristics of the respondents, including the number and percentage of teachers in each subgroup. This table suggests that the sample is rather well balanced in terms of grade level, years of teaching experience, and age.

Table 1

Demographic Characteristics of Respondents

Characteristic	*f*	%
Grade Level		
Pre-K through Grade 2	31	23.7
Grades 3 through 5	33	25.2
Grades 6 through 8	31	23.7
Grades 9 through 12	28	21.4
Not Answered	8	6.1
Years of Teaching Experience		
Less than 1-2 years	15	11.5
3-5 years	12	9.2
6-10 years	32	24.4
11-15 years	31	23.7
More than 15 years	35	26.7
Not Answered	6	4.6
Age		
20-30 years	29	22.1
31-40 years	30	22.9
41-50 years	36	27.5
51-60+ years	29	22.2
Not Answered	7	5.3
Level of Education		
Bachelors' Degree	40	30.5
Masters' Degree or Above	84	64.1
Not Answered	7	5.3
Gender		
Male	21	16.0
Female	103	78.6
Not Answered	7	5.3

Subject Matter Domains

The teachers who were surveyed taught core subjects in grades kindergarten through 12. In the lower grades, most teachers typically teach all basic subjects, so percentages did not equal 100%. The teachers could check the "All that Apply" option. The results include teachers who teach business (2.3%), English/language arts (42.7%), fine and applied arts (3.1%), health and physical education (6.1%), history/social studies (43.5%), mathematics (51.1%), reading/literacy (51.9%), science (41.2%), and vocation/technical courses (2.3%). Table 2 shows the number of teachers and percentages that teach each subject.

Table 2

Subject Matter Domains in Which Respondents Teach (N = 131)

Subject Area Taught	*f*	*%*
Business	3	2.3
English/Language Arts	56	42.7
Fine and Applied Arts	4	3.1
Health/Physical Education	8	6.1
History/Social Studies	57	43.5
Math	67	51.1
Reading/Literacy	68	51.9
Science	54	41.2
Vocational and Technical	3	2.3

Descriptive Statistics

Descriptive statistics directly related to the research questions are shown in Tables 3 through 6. Table 3 indicates teachers' frequency of use by the type of technology. The frequencies were divided into "daily," "one to three times a week," and "less than weekly to never." As Table 3 reveals, most of the teachers sampled (70.5%) used wireless internet daily. The LCD projector was used daily by nearly 62% of the teachers sampled, and at nearly 50% of the participant teachers, daily usage of computing devices closely followed. At the other extreme, only a handful of the teachers reported daily use of student response systems (2.5%), video or voice recording mechanisms (3.4%), digital cameras (3.3%), and e-readers (4.9%). Computing devices used by students themselves were employed daily in instruction by fewer than one-third of the teachers (31.1%) and slightly more than one-third of the sampled teachers between 1 and 3 times weekly (35.2%).

The frequencies pertinent to respondents' 1-item self-assessment of the overall level of technology integration in their classrooms and their 6-item assessment of the extent to which of technology use and integration has positively impacted teaching and learning are highlighted in Table 4. With respect to the former, over half of the responding teachers felt that technology was strongly or very strongly integrated into their classes (50.8%) while nearly the same number of teachers felt that technology was at least "somewhat" integrated in their classes (45.9%). With respect to the latter, teachers seemed consistently upbeat about the impacts of technology on their classrooms, with the item-level of agreement observed to vary between 75.1% (minimum) and 93.5% (maximum).

Table 3

Respondent Self-Report of Frequency of Use by Type of Technology

Type of Technology	Daily		One to Three Times Weekly		Less than Weekly/ Never/NA	
	n	*%*	*n*	*%*	*n*	*%*
Wireless internet access	86	70.5	21	17.2	15	12.3
LCD projector	74	61.7	33	27.5	13	10.8
Document camera	40	32.5	29	23.6	54	43.9
Interactive whiteboard	27	22.3	23	19.0	71	58.7
Student computing device (laptops, etc.)	38	31.1	43	35.2	41	33.6
Teaching computing device (laptops,etc.)	60	49.6	40	33.1	21	17.4
E-reader device (Kindle, Sony Reader)	6	4.9	10	8.1	107	87.0
Student response systems (clickers)	3	2.5	19	15.7	99	81.8
Video or voice recording mechanism for lectures	4	3.4	6	5.0	109	91.6
TV monitor/VCR/DVD player	13	10.6	29	23.6	81	65.9
Digital camera	4	3.3	13	10.7	105	86.1

Table 4

Respondent Self-Report of Overall Level of Technology Integration and Classroom Impacts of Technology Use and Integration

Item	Very Weakly/ Weakly		Somewhat		Strongly/ Very Strongly	
	n	*%*	*n*	*%*	*n*	*%*
Integration Level	4	3.23	57	45.97	63	50.81
Item	Strongly Disagree/ Disagree		Neutral		Agree/ Strongly Agree	
	n	*%*	*n*	*%*	*n*	*%*
The use of computers has increased the level of student interaction and/or collaboration.	6	4.88	24	19.51	93	75.61
The integration of technology has positively impacted student learning and achievement.	0	0.00	8	6.50	115	93.50
My teaching is more student-centered when technology is integrated into the lessons.	8	6.50	17	13.82	98	79.67
Technology integration efforts have changed classroom learning activities in a very positive way.	2	1.63	12	9.76	109	88.62
My teaching is more interactive when technology is integrated into the lessons.	6	4.88	11	8.94	106	86.18

The final set of item-level frequencies was related to the impact that technology integration has had on the development of students' higher order skills. As shown in Table 5, the 21st century skill upon which teachers deemed technology had the greatest impact concerned students' fluency with research and information (52.46% great/very great). While only about one-third of the teachers sampled answered that technology usage had a great or very great impact on student creativity and innovation (36.59%), the percentages of sampled teachers who indicated only a slight or very slight impact of technology on students' written and verbal communication (66.38%) and collaboration (54.32%) skills was surprising.

Table 5

Respondent Self-Report of the Impact of Technology Integration on the Development of Students' Higher-Order Skills

Skill	Very Slight/ Slight		Some		Great/ Very Great	
	n	*%*	*n*	*%*	*n*	*%*
Creativity/Innovation	19	21.28	59	47.97	45	36.59
Critical thinking	22	16.35	47	38.21	54	43.90
Problem-solving	24	10.58	41	33.61	57	46.72
Research/Information Fluency	27	4.92	31	25.41	64	52.46
Written/Verbal Communication	23	66.38	45	36.89	54	44.26
Collaboration	20	54.32	47	38.21	56	45.53

Research Questions

Research Question 1

The first research question was, "To what extent does the frequency of teachers' use of technology differ by grade level taught, years of teaching experience, age, gender, and level of education?" The means (*M*s) and standard deviations (*SD*s) for technology usage, integration level, and classroom impacts, grouped according to the respondents' grade level taught, years of experience, age, and level of education are summarized in Table 6. A cursory inspection of this table seems to indicate that that the participants' responses were generally more homogeneous with the exception of their levels of technology usage. Regarding grade levels taught, teachers in lower grades (grades kindergarten through 5) tended to use technology in the classroom more than teachers in higher grades (i.e., grades 6 through 12). More specifically, while the means for teachers in grades K through 2 ($M = 22.00$, $SD = 6.64$) and grades 3 through 5 ($M = 21.59$, $SD = 6.05$) comfortably exceed 20.00, those observed for teachers in grades 6 through 8 ($M = 14.17$, $SD = 5.78$) and 9 through 12 ($M = 16.14$, $SD = 6.35$) were nearly an *SD* lower. While less pronounced, noteworthy mean differences in technology usage may also be observed by teachers' years of experience and age, with those teachers who had been teaching 6 to 10 years ($M = 20.41$, $SD = 7.23$) claiming somewhat more technology usage than those with other levels of experience and the teachers under 40 years of age indicating somewhat more technology usage than teachers over 40 years of age.

Formal testing of these differences using ANOVA largely confirms what was observed by inspection. As shown in Table 7, a highly significant difference in mean level of technology use was observed by teachers' grade levels ($F(3,116) = 11.\ 92$, $p <$

.001), but not by these teachers' years of teaching experience (F(3,116) = 1.31, p = .273), ages (F(3,116) = 0.67, p = .573), or levels of education (F(1, 118) = 1.32, p = .252). As noted in Table 7 and consistent with what was observed by simple inspection, formal post-hoc testing of the *M*s by grade level indicated that the means for the two lower grades differed from those in the two upper grades, but there was no difference between the means observed within these two grade-level tiers.

Research Question 2

The second research question was, "To what extent does the teachers' self-assessed level of technology integration differ by grade level taught, years of teaching experience, age, gender and level of education?" Inspection of the *M*s obtained for technology integration (Table 6) suggests only slight differences among subgroups and no systematically increasing or decreasing pattern in the *M*s observed as the respondents' grade levels, ages, years of experience, or levels of technology systematically increased or decreased. As shown in Table 7, using ANOVA to formally test for differences among the subgroup *M*s suggests statistically significant differences by grade level (F(3,116) = 3.18, p = .027)—such that the mean for grades 3 through 5 (M = 3.94, SD = 0.84) differs from that for grades 9 through 12 (M = 3.36, SD = 0.73)—but only for that variable. No statistically significant differences were observed among the group *Ms* for level of technology integration by teachers' years of experience (F(3,116) = 2.53, p = .060), age (F(3,116) = 1.50, p = .219), or level of education (F(1,118) = 0.55, p = .458).

Table 6

Means and Standard Deviations for Technology Usage, Integration Level, and Classroom Impacts by Grade Level Taught, Years of Experience, Age, and Level of Education (N = 120)

Group		Technology Use		Integration Level		Classroom Impacts	
	n	*M*	*SD*	*M*	*SD*	*M*	*SD*
Grade Level Taught							
PK - 2	31	22.00	6.64	3.65	0.71	4.22	0.65
3 - 5	32	21.59	6.05	3.94	0.84	4.11	0.70
6 - 8	29	14.17	5.78	3.52	0.74	4.10	0.58
9 - 12	28	16.14	6.35	3.36	0.73	3.99	0.48
Years of Experience							
5 yrs or less	26	17.54	7.50	3.58	0.76	4.05	0.64
6-10 yrs	32	20.41	5.76	3.94	0.76	4.23	0.50
11-15 yrs	30	17.27	7.23	3.50	0.78	4.13	0.51
15 yrs or more	32	19.03	7.45	3.47	0.76	4.01	0.75
Age							
20-30 yrs	28	19.21	7.23	3.82	0.67	4.28	0.59
31-40 yrs	30	19.83	6.06	3.73	0.87	4.08	0.48
41-50 yrs	34	17.59	7.53	3.50	0.75	4.13	0.55
51-60+ yrs	28	18.04	7.25	3.46	0.79	3.94	0.77
Level of Education							
Bachelor's	40	19.68	8.66	3.70	0.88	4.19	0.59
Bachelor's +	80	18.11	6.04	3.59	0.72	4.07	0.62
Totals	120	18.63	7.02	3.63	0.78	4.11	0.61

Table 7

Analysis of Variance Summary Tables for Technology Usage, Integration Level, and Classroom Impacts by Grade Level Taught, Years of Experience, Age, and Level of Education (N = 120)

Variable and Source	*SS*	*MS*	*F*	*p*	η_p^2
Grade Level Taught (*df* 3, 116)					
Technology Use					
Between	1382.58	460.86	11.92	.000	0.24
Within	4483.29	38.65			
Integration Level					
Between	5.48	1.83	3.18	.027	0.08
Within	66.64	0.57			
Classroom Impact					
Between	0.80	0.27	0.72	.543	0.02
Within	43.27	0.37			
Years of Experience (*df* 3, 116)					
Technology Use					
Between	192.85	64.28	1.31	.273	0.03
Within	5673.02	48.91			
Integration Level					
Between	4.44	1.48	2.53	.060	0.06
Within	67.69	0.58			
Classroom Impact					
Between	0.90	0.30	0.81	.491	0.02
Within	43.17	0.37			

(Table 7 continues)

(Table 7 continued)

Variable and Source	*SS*	*MS*	*F*	*p*	η_p^2
		Age (*df* 3, 116)			
Technology Use					
Between	99.79	33.26	0.67	.573	0.02
Within	5766.08	49.71			
Integration Level					
Between	2.69	0.90	1.50	.219	0.04
Within	69.44	0.60			
Classroom Impact					
Between	1.68	0.56	1.54	.209	0.04
Within	42.39	0.37			
		Level of Education (*df* 1, 118)			
Technology Use					
Between	65.10	65.10	1.32	.252	0.01
Within	5800.76	49.16			
Integration Level					
Between	0.34	0.34	0.55	.458	0.01
Within	71.79	0.61			
Classroom Impact					
Between	0.37	0.37	0.99	.321	0.01
Within	43.71	0.37			

Note. For Technology Usage, means for both Pre-K to Grade 2 and Grades 3 to 5 differ from the means for Grades 6 to 8 and Grades 9 to 12. Neither of the former pair of means or the latter pair of means differ between themselves. For Integration Level, mean for Grades 3 to 5 differs from the mean for Grades 9 to 12.

Research Question 3

The third research question was, "To what extent do teachers' perceptions of the classroom impacts of technology use and integration differ by grade level taught, years of teaching experience, age, gender, and level of education?" As previously indicated, the majority of sampled teachers either agreed or strongly agreed that the use of technology in their classrooms had a decidedly positive impact on teaching and learning. As a result, most of the subgroup means for classroom impacts were at or above a value of 4 on the response scale (Table 6); no subgroup mean differences were observed when ANOVAs were conducted by grade level ($F(3, 116) = 0.72$, $p = 0.543$), years of teaching experience ($F(3, 116) = 0.81$, $p = 0.491$), age ($F(3, 116) = 1.54$, $p = 0.209$), and level of education ($F = 0.99$, $p = 0.321$)

Research Question 4

The fourth research question was, "To what extent are student acquisition of skills in creativity and innovation, critical thinking, problem-solving, research and information fluency, written and verbal communication, and collaboration related to teachers' frequency of technology usage?" Table 8 includes the *M*s and *SD*s for teachers' perceptions of students' skill development and their perceptions of technology usage, integration level, and classroom impacts. The correlations between these variables and the 21st century skills outlined in the questionnaire are summarized in Table 9.

For technology usage, no statistically significant correlation was obtained for technology usage and students' fluency in written and verbal communication ($r = 0.156$), and only a weak correlation was observed between technology integration and students' fluency in research and information ($r = .216$). More substantial, but still modest, were

the correlations between technology usage and problem-solving (r = .278), critical thinking (r = .301), collaboration (r = .304), and especially creativity/innovation (r = .329).

Table 8

Means and Standard Deviations for Teacher Perceptions of Students' Skill Development and their Perceptions of Technology Usage, Integration Level, and Classroom Impacts (N = 118)

Student Skills	*M*	*SD*
1. Creativity/Innovation	3.28	0.95
2 .Critical Thinking	3.30	0.98
3. Problem-Solving	3.35	0.97
4. Research/Information Fluency	3.39	1.10
5. Written/Verbal Communication	3.25	1.02
6. Collaboration	3.36	1.03
7. Technology Usage (sum)	18.74	7.03
8. Integration Level	3.64	0.78
9. Classroom Impacts	4.11	0.61

Table 9

Correlations between Teacher Perceptions of Students' Skill Development and their Perceptions of Technology Usage, Integration Level, and Classroom Impacts (N = 118)

Student Skills	Technology Usage	Technology Integration	Classroom Impacts
1. Creativity/Innovation	.329***	.438***	.566***
2 .Critical Thinking	.301**	.455***	.525***
3. Problem-Solving	.278**	.461***	.557***
4. Research/Information Fluency	.216*	.266**	.250**
5. Written/Verbal Communication	.156	.328***	.413***
6. Collaboration	.304**	.409***	.513***

***$p < .001$. **$p < .01$. *$p < .05$.

Research Question 5

The fifth research question was, "To what extent are student acquisition of skills in creativity and innovation, critical thinking, problem-solving, research and information fluency, written and verbal communication, and collaboration related to teachers' self-assessed levels of technology integration?" As also shown in Table 9, teachers' self-assessed levels of technology integration appear to be consistently linked to the impact of technology on students' 21st century skills. As seen with technology usage, the weakest correlations between technology integration and students' skill development were for student fluency for research and information fluency ($r = .266$) and written and verbal

communication (r = .328). Regarding the relationships between technology integration and the skills of collaboration (r = .409), problem-solving (r = .461), critical thinking (r = .455), and creativity and innovation (r = .438), the remaining correlations all exceed a value of r = .40 (moderate relationship) and are all highly statistically significant ($p < .001$).

Research Question 6

The sixth research question was, "To what extent is student acquisition of skills in creativity and innovation, critical thinking, problem-solving, research and information fluency, written and verbal communication, and collaboration related to teachers' perceptions of the classroom impacts of technology use and integration?" Finally, as also shown in Table 9, systematic relationships are observed between teachers' perceptions of the positive impacts of technology on teaching and learning in general and the more specific impacts of technology on students' development of 21st century skills. As with technology usage and integration, the lowest correlations seen are those concerning research and information fluency (r = .250) and written and verbal communication (r = .413). More robust, however, are the correlations between the perceptions of classroom impact and students' development of skills for collaboration (r = .513), critical thinking (r = .525), problem-solving (r = .557), and creativity and innovation (r = .566).

Summary of Findings

The most significant result was that teachers at lower grade levels (grades K through 5) use more technology than upper-grade teachers (grades 6 through 12). There appeared to be a slight relationship between teachers' years of experience and their ages regarding technology usage. Those teaching between 6 and 10 years claimed somewhat

more technology usage than those with a different range of years of experience. Also, teachers who were under the age of 40 years reported using more technology than teachers over age 40.

Findings were also found with the correlations among the 21st century skills. A weak correlation was seen between technology integration and students' fluency in research and information. Furthermore, a modest correlation emerged between technology usage and problem-solving, critical thinking, collaboration, and creativity and innovation. The weakest relationship was between technology integration and students' development of skills in research and information fluency and for written and verbal communication. Also, technology integration was statically significant in regards to collaboration, problem-solving, critical thinking, and creativity and innovation. Overall, the teachers think technology has a positive impact on their students. Ironically, teachers reported that research and information fluency and written and verbal communication are used least when considering technology usage and integration. Finally, relationships existed between collaboration, critical thinking, problem-solving, and creativity and innovation and teachers' perceptions of the impacts of technology use and integration in the classroom.

Chapter 4

Discussion, Recommendations, and Conclusion

Discussion of Findings

This study explored teachers' use of technology and examined if technology is being used to prepare students to be successful in the 21st century. The most significant finding was that teachers in the lower grades (K through 5) use more technology than teachers in the upper grades (6 through 12). This is consistent with the findings from The MetLife Survey (as cited in Markow, Macia, & Lee, 2013), which suggests that principals at elementary schools are more likely to encourage technology competence than those at secondary schools.

If principals are promoting technology more in lower grades, then it is likely that those principals are providing more opportunities for their teachers to attend technology-focused professional development sessions. When there is a school-wide implementation, it is easier for teachers to apply the things they are learning, and it creates a forum for them to discuss what does and does not work in their classrooms as well as help each other adhere to the newly implemented strategy or policy. It is also reasonable to expect that all teachers are teaching their curriculum at a rapid pace. Since many of the teachers in this school district are self-contained in the lower grades, meaning one teacher is responsible for all subjects, these teachers are able to integrate the subjects. Technology is one of the ways this can be done. Since teachers in the upper grades are responsible for individual subjects, there is less subject integration. Another factor contributing to teachers not using technology might be the lack of computers in secondary classrooms.

According to The Institute for Education Sciences (2000), high schools reportedly have fewer computers in each classroom than elementary schools.

There was slight difference in teachers' technology usage and their years of experience. Teachers who had been teaching from 6 to 10 years claimed somewhat more technology usage than those at different years of experience. First-year teachers may be overwhelmed with classroom management, policies and procedures, parents, and new school environments, which may collectively create difficulty in integrating technology. Incorporating technology can be a challenge until a teacher is comfortable and has been teaching for a few years. Starr (2012) compiled a list of teachers' worst, funniest, and best experiences as a teacher. Teachers' reported their first years as their worst, discussing that they always felt behind and as if they could not catch up; this interferes with the time it takes to learn how to teach with technology. Also, a teacher who has been teaching for 10 or more years might not see the need to use technology if he or she has not always used it. In addition, Starr (2012) reported that those who teach classroom teachers how to use technology struggle with veteran teachers during technology training seminars. More experienced teachers considered technology a waste of time and lacked the desire to learn how to perform simple tasks, such as checking e-mail. Therefore, teachers who have taught for between 6 and 10 years are comfortable trying new things, and they have not formed inflexible teaching habits.

Teachers under the age of 40 years reported using more technology than teachers over 40. Since technology has been present for most of the younger teachers' lives, some are more familiar with technology and can use it with more ease than older teachers who did not grow up with these devices. Older teachers are comfortable with their existing

teaching habits, which did not include technology. In most cases, younger teachers have completed their teacher education programs more recently than older teachers. Many of these programs show teachers how to use technology with ease. If teachers use technology while learning how to perform the duties associated with their jobs, then they are more apt to use it while teaching.

A weak correlation was detected between technology integration and students' fluency in research and information and written and verbal communication. A possible reason associated with research and information fluency is that students may not do much research in the lower grades, and in upper grades, students do research at home. Therefore, teachers are not using classroom instructional time to show their students how to utilize technology for research purposes. Also, teachers in the district examined in the current study reported that they do not use technology to sharpen their students' written and verbal communication skills. Lack of time and lack of equipment could play a significant role in this, as teachers may not have enough time or may not have as many computers as they have students. Verbal communication is not found in curriculum standards, so some teachers are not spending time, with or without technology, to teach it. It is also a complex skill to test, so it is not at the forefront in most classrooms. Also, teachers might be allowing students to work on computers in groups without realizing that such exercises are enriching students' communication skills.

Connections were found between technology usage, technology integration, and teachers' perceptions and the skills of problem-solving, critical thinking, collaboration, and creativity and innovation. Teachers are not only using technology and integrating it into other subjects, but they deem it necessary to teach these important life skills. This

could be the result of principals' awareness and professional development seminars. Also, teachers may find that technology have these skills already embedded into many activities. These skills must be taught, and technology can enforce the skills to aid student preparation.

Teachers reported that technology is positively impacting their classrooms. Having a positive attitude toward technology can make a difference in the ways teachers perceive rapid technological change. The literature (Jacobs, 2010; Morrison & Lowther, 2010; Trilling & Fadel, 2009) shows that technology can prompt teachers and students to ensure readiness for college and the workforce Ironically, in the upper grades, teachers reported less use of technology than teachers in lower grades, yet they still think it is positively impacting their classrooms. Secondary schools may not be equipped with as much in-class technology as the elementary schools. Although teachers know technology improves their classrooms, they might not have time to go to a computer laboratory since most students at most middle schools and high schools switch classrooms. Also, elementary teachers' professional development may be technology-driven, whereas professional development for teachers in upper grades may be more focused on testing and high school graduation. There should be future study to determine the reasons why teachers think they should be using technology but choose to use it only minimally.

Recommendations

Recommendations based on the study's findings can be grouped into two categories: (1) recommendations for policy and practice and (2) recommendations for future study. Although significant differences among teachers in technology use were

found and there was statistical evidence that teachers are teaching 21st century skills, there is still much to explore as related to technology and 21st century skills.

Policy and Practice

There are practical uses for this study for stakeholders in the educational system, as there is much concern about the students exiting high school unprepared for society, college, and the workforce. The recommendations for application in the educational system include:

1. Principals in the upper grades can use this data to provide more professional development opportunities focused on strengthening technology use.
2. Since there is already a shift towards the Common Core Standards in most states, curriculum developers can use the study's findings to focus more on the 21st century skills as they continue to develop the curriculum and aid teachers in teaching the skills. In addition, test developers can continue to create testing materials focusing on these skills. If students are tested on these skills, then these skills will become the focus in the classroom.
3. Colleges and employees are detecting a shift toward teaching the skills needed. They can reach out to schools to let them know what they are seeing and what could be improved as the focus in schools.
4. Other school systems can use this study's findings to survey their teachers to determine if this is a trend and what they can do with results that are significantly different or that do not correlate.

Future Research

Recommendations for future study to aid in education can be divided into three categories: (1) using outcomes of this study, (2) studying professional development and school climates, and (3) other studies involving technology and 21st century skills. Using the outcomes of the current study, there could be future studies to enhance and dissect certain topics, such as:

1. Decipher how 21st century skills can be connected to the Common Core curriculum.
2. Explore the 21st century skills to identify the correlations between these skills and the different grade levels.
3. Dissect and identify the best technological devices for teaching each of the 21st century skills.
4. Study teachers from different school systems, which may provide differences such as socioeconomic status, racial diversity, school type (e.g., private vs. public), and school setting (e.g., urban vs. rural).
5. Explore the differences (if any) between technology use by female teachers and male teachers to determine if men or women teach more 21st century skills. (The sample size in the current study was not large enough for a gender investigation.

In addition, there are also recommendations to study professional development and school climate, which include:

1. Investigate the difference in professional development for teachers in the lower versus higher grades. This could encompass the number of hours required and mandatory versus teacher-selected professional development hours.

2. Consider the pressure placed on teachers by their principals to use technology in secondary classrooms. This may encompass examining the ways principals are ensuring that teachers are using technology (e.g., walk-throughs, observations, written evidence).
3. Observe and monitor the steps being done to promote the teaching of 21st century skills. Are principals and other faculty members discussing these skills? Are these skills part of the curriculum?
4. Search for the most effective training models to deliver professional development. This study would examine teachers' views of their most effective technology training methods, the times that training should take place, and the types of technology that should be taught.

Addition studies involving technology and 21st century skills include:

1. Using qualitative measures, observe and interview teachers and students to see how much technology is being used in the classroom. (This study only examined teachers' perceptions, which may differ from what is actually happening in classrooms.) The 21st century skills could be similarly observed.
2. Survey students to explore the types and amount of technology their teachers are using in the classroom. (This study only considered the teachers' perspectives.)
3. Study the effectiveness of modern-day classroom technology, since technology rapidly changes and new devices are constantly emerging.
4. Explore the reasons that technology is not being used in classrooms.

5. Using a longitudinal study method, follow students from kindergarten through 12th grade using a curriculum that teaches the 21st century skills to see if students are prepared for the workforce or college upon graduation from high school.

Conclusion

Preparing children for the 21st century should be a priority since they are the future of the United States. School systems should be preparing students to be motivated, hard-working, and technology-savvy citizens with the knowledge to think independently (Jacobs, 2010), as students are entering the classrooms with more knowledge of technology than ever before. Schank (2002) stated:

> Is intelligence an absolute? Does mankind get smarter as time goes by? It depends on what you mean by intelligence, of course. Certainly we are getting more knowledgeable. Or at least it seems that way. While the average child has access to a wealth of information, considerably more than was available to children fifty years ago, there are people who claim that our children are not as well educated as they were fifty years ago and that our school have failed us. (p. 206)

Educators have the ability to not allow the school systems to fail. Although there is a plethora of information and technology, there has to also be a shift in the mindsets of those in the education system, starting with the policymakers and filtering down to the students. Everyone must be involved in the education of children to ensure that they will thrive in the 21st century. Jacobs (2010) hopes, "When educational historians study the 21st century classrooms, they will say that it was a time of great change and that change was driven by the technology skills that tech-savvy students brought to the classrooms" (p. 209).

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Appendix A

Technology used in your Classroom during Instructional Time Survey

Directions: Please take the time to complete this survey about your use of technology during instructional time in your classroom. In this survey, "*technology*" refers to computers or computer-related devices. Read each question and place a check or X beside or under the answer that best describes your answer.

21st century education is defined as a curriculum that uses technology to enhance students' skills of creativity and innovation, critical thinking, problem solving, research and information fluency, digital citizenship, communication, and collaboration.

1. How many years have you taught?
   - ☐ Less than 1 year
   - ☐ 1-2 years
   - ☐ 3-5 years
   - ☐ 6-10 years
   - ☐ 11-15 years
   - ☐ More than 15 years

2. What is your gender?
   - ☐ Female
   - ☐ Male

3. Please mark the appropriate range for you age?
   - ☐ 20-30
   - ☐ 31-40
   - ☐ 41-50
   - ☐ 51-60
   - ☐ 61+

4. What grade level(s) do you currently teach? Please mark all that apply.
   - ☐ Kindergarten-3rd
   - ☐ 4th and 5th
   - ☐ 6th-8th
   - ☐ 9th-12th

5. What subject(s) do you currently teach? Please mark all that apply.
   - ☐ Business
   - ☐ English/Language Arts
   - ☐ Fine and Applied Arts
   - ☐ Health/Physical Education
   - ☐ History/Social Studies
   - ☐ Math
   - ☐ Reading/Literacy
   - ☐ Science
   - ☐ Vocational and Technical

6. What is the highest degree you have earned?

- ☐ Bachelors
- ☐ Masters
- ☐ Doctorate

7. To what extent is technology integrated into your classes? Please rate on a scale of one to five, where one is not at all integrated and five is fully integrated.
1=Not at all integrated 2 3 4 5=Fully integrated
Rating:_____

Please rate on a scale of one to five, where one is not at all acquiring the skills and five is fully acquiring the skills. Place a check under the rating.

8. Through the use of technology, to what extent do you perceive your students to be acquiring the following skills.	1=Not at all acquiring the skills.	2	3	4	5=Fully acquiring the skills.
Creativity and innovation skills					
Critical thinking skills					
Problem solving skills					
Research and information fluency skills					
Written and verbal communication skills					
Collaboration skills					

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
9. The use of computers has increased the level of student interaction and/or collaboration.					
10. The integration of technology has positively impacted student learning and achievement.					
11. My teaching is more student-centered when technology is integrated into the lessons.					
12. Technology integration efforts have change classroom learning activities in a very positive way.					
13. My teaching is more interactive when technology is integrated into the lessons.					

14. Place a check by the frequency to which you use each device. If you do not have access to the device or it does not work, check Not Applicable.

	Daily	3 times a week	Once per week	Less than weekly	Never	Not Applicable
Wireless internet access						

LCD projector						
Document camera						
Interactive whiteboard						
Student computing device (laptops, netbooks, smartphones, desktop computers, mobile laptop cart)						
Teaching computing device (laptops, netbooks, smartphones, desktop computers, mobile laptop cart)						
E-reader device (Kindle, Sony Reader)						
Student response systems (clickers)						
Video or voice recording mechanism for lectures						
TV monitor/VCR/DVD player						
Digital camera						

Thank you for your time!
This survey was developed by inTASC at Boston College.

Appendix B

IRB Form

. Basic Information (See Initial Review Request Guidelines Section 1)

1.a: Melinda Hallock

BannerU#U00403143	Academic Unit: Instruction and Curriculum Leadership
Last name: Hallock	First Name: Melinda
Email address: melindahallock@gmail.com	
Investigator type: Request for Study Approval	CITI Training Info:
Faculty Duane Giannangelo	Completion Report # 6753495
Student Melinda Hallock	Completion Date:10/01/2011
External	

1.b: Contact Person (if different from lead investigator)

Contact Banner U#	Contact Email:
Contact Last Name:	Contact First Name:

1.c: Faculty Advisor (this section required for students only)

BannerU#(e.g., U12345)U00002365	Academic Unit: ICL
Last name: Giannangelo	First Name: Duane
Email address:	
	CITI Training Info:
	Completion Report # 6752493
	Completion Date: 9-23-11

1.d: Study Information

Study Title:*The Acquisition of 21st Century Skills with the Integration and Use of Technology
Anticipated Number of Subjects:*292
Co-Investigators:
Submission Type: * Exempt Study ☒ Secondary Analysis of Existing Data Only ☐ All Other Studies ☐
Externally Funded?* ☐Yes ☒No

1.e: Affirmations

By checking the box below, Investigator affirms the following:
1) The research will not be initiated until written approval is secured from the IRB.
2) I will conduct this study as described in the approved study. If any changes are anticipated, I will contact the IRB staff prior to implementing the changes and request the appropriate form or procedure. I will not implement the changes until I receive approval from the IRB or its staff.

3) I will contact the IRB staff immediately if any of the following events occur: unanticipated problems involving risks to subjects, study deviations, and findings during the study that would affect the risks or benefits of participation.
4) If you are a student, you also affirm your understanding that approval of your Faculty Advisor is required before this document is submitted to IRB.

Investigator affirms:* ☒**Yes** ☐**No** **Date Affirmed: 3/29/13**

By checking the box below, Faculty Advisor affirms the following (required for graduate and undergraduate student research):
1) I have reviewed and approved the research plan of the student(s).
2) I assume responsibility for ensuring that the student(s) conducting research are aware of their responsibilities as researchers
3) The IRB will be immediately informed in the event of unanticipated problems involving risks to subjects, study deviations, or findings during the study that would affect the risks or benefits of participation.
4) I will submit the reviewed study to irb@memphis.edu on behalf of my student

Faculty Advisor affirms: **Yes** **Date Affirmed: 3-28-13**

***Required fields**

2. Purpose of the Study (See Initial Review Guidelines Section 2)

It is the purpose of this study to look at the use of technology among teachers to determine if they are using technology and teaching the necessary skills in order to prepare their students to be successful in the 21st century.

Much research has examined the use of technology in schools. However, as we have entered the 21st century, teachers have seen an influx in working computers in their classrooms, teachers have been trained to use technology through teacher education programs and professional development, technology is a major component in today's society, and technology is changing at a rapid pace. The utilization of technology by teachers is now a necessity in daily teaching (Morrison & Lowther, 2010; Rubenstein, 2010). With advances in technology, some teachers are still using technology minimally. Nonetheless, many teachers are incorporating technology in each daily lesson with great student success. Thus, a study of the degree to which teachers are using technology is relevant.

This study also looks at the implementation of the 21st century skills. Certain skills are needed for students to be successful in college and/or to compete for quality jobs and to maintain those jobs. These 21st century skills include creativity and innovation skills, critical thinking skills, problem solving skills, research and information fluency skills, written and verbal skills, and collaboration skills (Jacobs, 2010; Trilling & Fadel, 2009). It is important to explore if teachers are teaching these skills. These skills will allow students to be successful if they choose to go to college or start a career after high school.

This study could be relevant because it will determine if age, gender, teaching experience, level of education, or grade taught plays a role in teacher integration or use of technology. It will also look at the correlation between the 21st century skills and technology use and integration.

3. Methods and Procedures (See Initial Review Guidelines Section 3)

The research design for this study consists of administering and interpreting the results of a survey (see Appendix A for survey). This quantitative study will be completed using a questionnaire designed by inTASC to determine the impact technology is having on student achievement. The intent of this study is to survey as many teachers possible in one school district to answer the research questions (see Appendix B for research questions).

The original inTASC questionnaire was shortened because the value of technology in the classroom was not relevant for this study. The questionnaire contains 14 individual items with some of those items containing multiple parts taking participants 5 to 10 minutes to complete.

The survey will be distributed to the participants via email made on a website called Survey Monkey (2013). The participants will have to sign a consent form before filling out the survey (see Appendix C for consent form). The consent form will ensure to the participants that there are no risks and that the survey is voluntary and answers will

be confidential. Answers will be confidential because teachers will not write their name on the survey. Everyone's link will be the same. The only people that will have access to the survey results will be the lead investigator, the faculty advisor, and the statistician that will help input the results into SPSS. The results will be secure with a username and password.

The participants will click on the link from their email to go to the survey.

4. Secondary Analysis of Existing Data (See Initial Review Guidelines Section 4)

Not Applicable.

5. Investigator(s) Qualifications (See Initial Review Guidelines Section 5)

The lead investigator has an interest in teaching with technology. She is a teacher who wanted to find out more about teaching with technology to improve her teaching. She has been to many conferences and professional development meetings to learn about technology and how to incorporate it. She also has a strong interest in teaching with 21st century skills to ensure students are successful when they graduate high school.

The lead investigator has conducted a small quantitative residency project dealing with technology in the classroom. She gave surveys to preservice teachers to analyze what types of technology were being used in the classrooms.

6. Human Subjects (See Initial Review Guidelines Section 6)

a. Characteristics

There will be 292 participants who will be asked to participate in the survey. All of the participants will be teachers in elementary, middle, and high school. Males and females will be asked to participate. The age range will be from 22-70 years old. There will be a plethora of ethnicities including Caucasian, African American, Hispanic, Italian, etc. (Ethnicity will not be gathered on the survey.)

b. Vulnerable Populations

There will not be a vulnerable population.

c. Pre-existing relationship to subject pool

The researcher is from the home town the school district is in. She was a student at one of the elementary schools that will be surveyed. She knows about 25 of the 292 teachers but will not have contact with the teachers. She will be in contact with the Superintendent , Director of Technology, and the principals of each school.

d. Subject Selection

Every teacher in the school district will be asked to take the survey. No one will be excluded. These participants were selected because the researcher is from the home town and could have access to the district. She tried other districts, but was denied access to the teachers.

e. Anticipated Number of Subjects

There are 292 teachers in the school district. This is the number that will be asked to participate.

7. Recruitment (See Initial Review Guidelines Section 7)

Subjects will be recruited based on employment in Gadsden, Alabama in the Gadsden City School System. An email will be sent to the subjects explaining what the research is, why it is being gathered, and what they will be asked to do (See consent form).

8. Subject Payment (See Initial Review Guidelines Section 8)

There will be no subject payment.

9. Potential Risks (See Initial Review Guidelines Section 9)

There are no risks to the participants of this study.

10. Potential Benefits (See Initial Review Guidelines Section 10)

There are no direct benefits to the participants of this study. However, research on the use of technology may allow teachers to realize they should be using more technology. It will allow the teachers to see the need for teaching 21st century skills to their students. Principals could use this information during the hiring process.

11. Assessment (See Initial Review Guidelines Section 11)

Findings of this research could allow board members and principals to invest more money and professional development towards technology and 21st century skills. Stakeholders can read the research to realize some students are not graduating high school with the necessary knowledge and application to be successful in the job setting or in college and hopefully help.

12. Privacy (See Initial Review Guidelines Section 12)

The privacy of each participant will be protecting. Every teacher will be sent a consent form and link to take the survey. Everyone's link will be the same, so the surveys will be anonymous. The investigator will never meet the participants.

13. Confidentiality (See Initial Review Guidelines Section 13)

The confidentiality of each participant will be protected. Participants will take the survey online. There will not be codes given to the participants. Everyone will have the same link to take the survey. The surveys will be completed on Survey Monkey. The lead investigator, faculty advisor, and statistician will be the only ones with the username and password to view the results. Results will only be viewed on a private computer with no one else in the room. The lead investigator, faculty advisor, and statistician will make sure they have logged out each time they walk away.

Results of the data will not include names of people, schools, school district, city or state.

14. Collaboration, Engagement & Sponsor Relationships

(See Initial Review Guidelines Section 14)

The Gadsden City School District in Gadsden, Alabama will be allowing the teachers to be used as participants in this study. Dr. David Asbury is the Director of Technology and Human Resources and granted permission for this to happen. (See email from Dr. Asbury, Appendix D)

Appendix C

Email to Gain Permission to Use Survey

9/13/11

Melinda Hallock <melindahallock@gmail.com>
to henry.braun

My name is Melinda Hallock. I am currently attending the University of Memphis and am seeking an EDD in Instruction and Curriculum Leadership. I am in a residency research class where I have chosen to seek what technology is being used during instructional time in K-5 classrooms. I am going to survey many teachers in the Memphis City School System This is a class to make sure I have the skills to write a dissertation down the road. I have run across your teacher survey and would love to use some questions from it. Please let me know if this would be possible. Of course, I would give full credit to Boston College and inTASC.

Thank you for your consideration,
Melinda Hallock

henry.braun
henry.braun@bc.edu
9/20/11
To melindahallock@gmail.com
Dear Ms. Hallock,
Feel free to use the survey. We only ask that you share your results with us when you have completed your project.
Good luck,
Henry Braun

Appendix D

Permission to Use the Survey

Hi,

My name is Melinda Hallock, and I am a graduate student at the University of Memphis. I am beginning my dissertation and am interesting in seeing if teachers are teaching 21st classroom skills. I have come across your survey titled WNC EdNET 21st Century Assessment Tool for Teachers. I was wondering if I could have permission to use some of the questions in my dissertation survey. I will be conducted the survey in Gadsden, Alabama.

Thank you for your consideration and time,

Melinda Hallock

Reply Forward

Bob Byrd <bbyrd@wresa.org> 7/2/12

to me

Melinda,
Feel free to use the survey questions.
Best wishes

Appendix E

Email to Gain Permission to Work with Schools

Appendix D

Apr 30

David Asbury <dasbury@gcs.k12.al.us> to Prissy, Yolando, Joel, Kim, Delsia, Nicole, Micah, Keith, Kristen, Russ, Sharon, Donna, Craig, Michelle, Ed, me

Please help Ms. Hallock out with her study by forwarding to your 'core' teachers, as requested.
(See informational e-mail below)

Participation has been approved by Dr. Miller.
-------- Original Message --------
Subject: Re: Questionnaire
Date: Tue, 30 Apr 2013 12:25:23 -0500
From: Melinda Hallock <melindahallock@gmail.com>
To: David Asbury <dasbury@gcs.k12.al.us>
References: <CAKadGPdxAPz94m8WP1E1zTNtSfzj6_Ms0fVLf4XprdFyNqg4Kw@mail.gmail.com> <517AAEB3.2080503@gcs.k12.al.us> <CAKadGPdab7U4_MMC6amQb5q31LYvUjNKb+0LvrbZYJoh-2WAqA@mail.gmail.com> <517E9C17.7060906@gcs.k12.al.us>

Dear Principals,

My name is Melinda Hill Hallock, and I graduated from Gadsden High School in 2002. I currently live in Memphis, Tennessee and am working on my dissertation to obtain a doctoral degree in Instruction and Curriculum Leadership from the University of Memphis. The Gadsden City School District is working with me to complete my dissertation.

My dissertation is titled "Students' Acquisitions of 21st Century Skills Using and Integrating Technology". I am asking that you forward this email along with the survey link and have your core teachers to complete it. The survey will take about 5 minutes and contains 10 questions asking about the use of 21st century skills and the use of technology in the classroom. Individual teachers, schools, and the school district will be kept anonymous.

I greatly appreciate your cooperation. I know things are hectic at the end of the school year and thank you for working with me. If you have any questions, please do not hesitate to contact me.

Thank you,

Melinda Hallock
melindahallock@gmail.com
(256)504-3003

Please click this link to complete the survey.
https://www.surveymonkey.com/s/technology_21stcenturyskills

Appendix F

Email to Principals

Melinda Hallock <melindahallock@gr

]May 14

to Prissy, Yolando, Joel, Kim, Delsia, Nicole, Micah, Keith, Kristen, Russ, Sharon, Donna, Craig, Michelle

Dear Principals,
Will you please forward this one more time? I really appreciate this.
Click to take the survey.
https://www.surveymonkey.com/s/technology_21stcenturyskills
Dear Teachers,

I am working on my dissertation at the University of Memphis researching 21st century skills and the use of technology. Many of you have already taken the survey and thank you very much! If you have not, please take 5 minutes to click on the link above to complete the survey.

Thank you for your support and cooperation,

Melinda Hill Hallock
melindahallock@gmail.com
(256) 504-3003
Survey link again https://www.surveymonkey.com/s/technology_21stcenturyskills