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A Study of West Virginia Teachers: Using 21st Century Tools to Teach in a 21st Century Context

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ABSTRACT

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Technology integration is reinforced not only by the National Educational Technology Standards but also the West Virginia Technology Standards, making teachers more accountable to use technology in their daily teaching practice. Because West Virginia has established a partnership with the Partnership for 21st Century Skills, West Virginia teachers are being encouraged to change instruction to meet the needs of 21st century learners. This includes being more student-centered by integrating instructional technologies to more actively engage students. By determining the frequency of integration of 21st century technology tools to create a 21st century context for learning and the factors that influence them, West Virginia has valuable information for promoting systemic change.

This study found that West Virginia teachers frequently use few 21st century technology tools, seldom use 21st century technology tools to create a 21st century context for learning, and identified supports and barriers that enable or prohibit their use of technology. In addition, the teachers provided examples of technology activities in which they frequently engage their students. The results provide the foundation on which to build professional development that will lead transformational change in technology integration in West Virginia schools.

DEDICATION

This dissertation is dedicated to those who make a difference in the lives of others. To my husband, Jim who constantly considers others and kept me going by knowing when I needed his support most. He always encouraged me and kept me focused on the "possible dream." To educators who make a difference in the life of every student who steps inside their classroom each and every day. And finally, to West Virginia teachers who have embraced using 21st century tools and utilize them to create a 21st century context for learning so that their students will become lifelong learners and make the world a better place for future generations.

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CHAPTER ONE: INTRODUCTION

Our daily lives and technology have become an integrated complex relationship making life very different from what it was over a decade ago. Technology has its presence in every aspect of life leaving few areas of society unaffected by technological change. Yet, education's response to the rapid changes brought about by technology is complex. When 22 students from three San Jose California area high schools were asked to describe the technological devices they had access to, they disclosed an extensive list. "Students households were typically equipped with multiple televisions and video cassette recorders, CD and DVD players, home computers, PDAs, pagers and cell phones" (Darah, 2001, p. 6). What exists at home however, does not necessarily exist at school. For example, when one student was asked whether he had a computer at home, he replied, "No, I have four" (p. 6). Based on the 5:1 student to computer ratio data (U. S. Department of Education, 2003), this same student may not have easy access to a computer at school.

The digital native commonly has multiple technology tools at home, but the same access to technology is not common in schools. At home many kids listen to an iPod, blog on MySpace, connect with friends on Facebook, use instant messaging (IM), and navigate the virtual world of Second Life, but at school these digital world activities may be against policy. Most schools acknowledge the importance of technology to their students' futures, but to date few have successfully incorporated technology into the mainstream of academic learning (Pearson & Young, 2002).

The mix of technology tools will change and evolve rapidly in the future. In fact, it has already changed since Darah's 2001 study. Today's technology may be outdated by

tomorrow. According to Steve Paine, West Virginia Superintendent of Schools, "It is impossible to predict the tools that will be essential for learning and working in the years to come. That is why it is important for people to acquire learning skills that will enable them to use next-generation technology so schools will stay abreast of new technology" (West Virginia Board of Education, 2006, p. iii).

Some students struggle to maintain pace in the world inside the school because many schools are still working in the style of an ancient education system. Outside the school, everything moves at an astonishing rate. Life is in a multi-tasking mode with technologically driven activities. Routine tasks have become automated with examples such as the use of a scanning device at department and grocery stores; electronic tickets at the airport and railway stations; online banking and share trading with computerized access to details related to account information; health monitoring systems, prescription dispensing, and surgical procedures; the way we play and gain access to music and books; social networking and communication; and more. As a whole, technology has transformed routine tasks that affect family, work and education, and man's overall approach to daily living. In *Debunking the Digital Divide*, Samuelson (2002) reported that increased computer use was noted across ethnic/racial groups, age, gender, and economic levels. Although various groups in society can perform routine tasks using technology, a digital divide still exists. The same is true in schools; the majority are still not keeping up the pace. Valadez and Duran's (2007) findings contribute to a "broader definition of the 'digital divide' that includes social consequences including the impact of social networks and wider use of technology to improve instruction" (p. 31).

Technology has been deeply embedded in our day-to-day life and the students' approach towards life and education is very much the same (i.e., technology oriented). Education at the PK-12 level needs to maintain a similar pace to retain its very purpose and importance. To maintain the relevancy to education, the wide gap between students' lifestyles and how they are being taught in school has to be filled. Other important factors in effective use of computers are staff training and technology support (Becker & Ravitz, 1999; Lawton, 1997; Wenglinsky, 1998).

People must be able to use technology to keep up in today's world. Students and teachers must have access to appropriate technology tools and resources so they can access information, solve problems, communicate clearly, make informed decisions, acquire new knowledge, and construct products, reports and systems (Abrami, 2001; Gordin & Pea, 1995; Haugland, 2000; Heft & Swaminathan, 2002; Peck, Cuban, & Kirkpatrick, 2002; Salzman, Dede, & Loftin, 1998). Education must be individualized and technology integration made accessible for use in all content areas. When teachers implement technology based devices, the needs of learners can be accommodated to satisfy diversity in the delivery of instruction. Green (1999) maintained that multifaceted complex instruction and resource rich environments give each child an opportunity to learn. Each student processes information in a different way. Identifying student learning styles and teaching to each student's particular style can increase academic achievement and develop positive attitudes toward learning. Dunn and Dunn (1995) claimed that all students learn when they are exposed to relevant learning style preferences. The ability to use multiple representations, modeling and visualization, and to work with abstract and multi-dimensional information is crucial (Salzman, *et. al*., 1998).

> Teacher familiarity, confidence, and skill in choosing software and integrating technology into the curriculum are dependent on teacher training and time for self-directed exploration and learning. Due to the relative newness of computer technology, many teachers have not received adequate training to select appropriate technologies and lack support to use them. It appears that the rapidly accelerating investments in computer hardware and software have not always been matched with the support and training needed by the teachers expected to improve the educational experiences of young children. Thus the mere presence of computers alone does not ensure appropriate or effective use. (Judge, Puckett, & Cabuk, 2004, pp. 386-387)

The student of today has access to and uses unlimited technological devices. "They take technology for granted - they expect it to be integral to their lives and to serve them, including in education" (Campbell, Oblinger, & Colleagues, 2007, no. 5, ¶1). Students can now be provided support from educational research databases and study materials online as well as other electronic resources. In the daily lives of students, they learn to use technology by experience.

According to Riel and Fulton (2001) it is necessary to create learning communities when given the task of teaching students new technologies. In learning communities the students are responsible for their own learning, creatively use available resources to construct knowledge, and develop the capacity to care about not just their own learning but the learning of their peers (Hocutt, Stanford, Wright, & Raines, 2002). Students today try things out and learn how to use advanced technological devices by

teaching others. However, while U.S. students may be sophisticated users of technology, research indicates they are not ready to compete in the 21st century workforce (Griffin & Kaleba, 2006). In *Are They Really Ready to Work,* Griffin and Kaleba reported findings from over 400 employers. Professionalism, work ethic, teamwork, and oral communication skills were among the skills sought by employers. Employers also noted increased demand for critical thinking skills, information technology, and creativity.

PK-12 education is now required to develop a new approach to integrating technology into the curriculum, not just as a subject but as a way to provide 21st century skills and tools regardless of what content is being taught. Meanwhile technology integration has been reinforced not only by the National Educational Technology Standards but also the West Virginia Technology Standards, making teachers more accountable to use technology in their daily teaching practice. Because West Virginia is part of the Partnership for 21st Century Skills initiative, West Virginia teachers are being encouraged to change instruction to meet the needs of 21st century learners by being more student-centered and by integrating instructional technologies to more actively engage students.

Background

Technology has had a presence in American schools for more than three decades. "Innovation in instructional technology throughout this [20th] century has usually been accompanied by optimistic claims of its ability to change, revolutionize, or improve some aspect of education" (Hollenbeck, 1998, p. 38). In the early 1980s the focus was a drill and practice, computer-assisted approach, where students worked at computers that were

intended exclusively for learning. Hollenbeck, discussing the work of Clark and Kay, shared the claims that instructional technology has made on revolutionizing education:

> Computers became 'tireless tutors' that would free both teachers from repetitive tasks of delivering instruction and make the act of educational delivery teacher-proof. That approach evolved rather quickly into one that enabled the teacher to use the computer to deliver instructional units that guide students through learning by providing support of curriculum. Sometimes the computer became the subject itself with classes in keyboarding and BASIC programming formed to develop 'computer literacy' among the students. Overall there were few instances of the computer acting in any capacity that could be called revolutionary. (p. 38)

Throughout the 20th century, the priority related to educational technology was to "develop efficient delivery of instruction. As such, it has supported the 'teaching as telling' model of instruction that has characterized most educational institutions in America" (Hollenbeck, 1998, p. 42). The new definition of educational technology has expanded from simple pen, paper, and pencils to a very modern two-way interactive video using handheld computers, calculators, and data collection devices. Reiser and Dempsey (2002) described instructional technology as tools other than the teacher, textbook, or chalkboards that are used to present and enhance instruction. The basic ingredients of a technology supported education system are the existence of networked computers, software, supporting peripherals and the Internet, and allowing teachers to integrate visuals into their lessons (Czubaj, 2002; Ryan & Cooper, 1998; Scardamalia, Bereiter, McLean, Swallow, & Woodruff, 1989). Students need to use technology tools to

enhance their own learning as they develop skills that enable them to think critically, analyze information, communicate, collaborate, and problem-solve rather than just watching the teacher use technology. Many different types of technology can be used to enhance and support learning and new uses of educational technology are emerging (Honey, Brunner, Light, Kim, McDermott, Heinze, Breiter, & Mandinach, 2002).

Becker's (1994) research shows that our society does not simply need teachers who know how to use computers. Becker's national survey of computer-using elementary and secondary teachers indicated that only five percent of responding teachers were using computers in developing things related to curriculum or for uses which can make substantial changes in instruction by integrating technology in core subjects. The computer was mostly being used for professional and administrative functions rather than instructional purposes.

Similar results can be observed in the School Technology and Readiness Report published by the CEO Forum (2001) which clearly states that more than half, in fact 55%, of the teachers who responded to the survey were found to be non-users of modern technology tools including the computer. The percentage of heavy users was extremely low, around 8%, while 32% were found to be moderate users. The teachers who used technology reported using computers for planning instruction and finding information for lesson planning but not for integrating technology into instruction.

In educating America's children for a technological world, schools must have the infrastructure in place before technology can be fully integrated into the curriculum. Findings from a national school facilities survey (U.S. General's Accounting Office, 1995) focused on determining whether America's schools have appropriate technologies,

such as computers, and the facility infrastructure to support these technologies, reported that, overall, the nation's schools were not even close to meeting their basic technology needs. Most schools do not fully use modern technology, and not all students have equal access to facilities that can support 21st century education, even when considering schools in the same district.

Both Becker (1994) and the CEO Forum (2001) concluded that even when 21st century technology tools are available, they are not being used for the kind of teaching and learning that a 21st century context promotes. *Education Week's* report, "Technology Counts 2006: The Information Edge, Using Data to Accelerate Achievement," ranked West Virginia as the top state for computer access, technology use, and technology capacity in schools. In its tenth annual report, "Technology Counts 2007: A Digital Decade," *Education Week* reported that educational technology access and the use of technology in West Virginia public schools are still among the best in the nation. West Virginia received an "A" for access to instructional technology, a category measured on the basis of the number of students in a classroom per computer in addition to the number of students per high-speed Internet connection. The state of West Virginia received an "A-" for the use of technology, determined by the availability and usage of virtual school courses and computer-based assessments in the state. The state's slip from an overall grade of "A" in 2006, when West Virginia led the nation, to a "B" in 2007 was caused by the decline from "A" to "C" in the category of capacity to use technology which fell between 2006 and 2007. It should be noted that the *State Technology Report 2007* grades are not comparable with those in the previous year's report because of changes in two

access indicators related to teacher and administrator licensure (Technology Counts 2007: A Digital Decade, 2007).

From a national perspective, West Virginia is one of only two states with all six technology integration policies in place which includes access to online academic content and/or instructional software through: 1) a group purchasing program, 2) collection of online resources from different academic areas, 3) subscription services, 4) online professional development, 5) professional or financial incentives to use technology for teachers, and 6) professional or financial incentives to use technology for administrators (Technology Counts 2007: A Digital Decade, 2007). Even though West Virginia includes technology in its teacher and administrator standards, at the time of this report, they did not include technology in initial or recertification licensing requirements for teachers or administrators (Technology Counts 2006: The Information Edge, 2006).

West Virginia Policy 5202, approved in August, 2007, provides the opportunity to improve teacher preparation programs in the state by including technology in initial teacher licensing requirements and recertification requirements. Being able to provide clear evidence that the practices are in place for the six individual state-policy indicators that measure the capacity to use technology should improve West Virginia's score in future Technology Counts reports.

The Partnership for 21st Century Skills is committed to transforming schools into centers with engaging curricula relevant to student needs. The use of technology in this case is not for the purpose of being presented as a separate subject but rather as a tool to promote and extend learning on a daily basis for PK-12 students. Technology has been embedded in our daily lives and the students' approach to life and education is much the

same, technology oriented. To maintain the relevancy to education, the wide gap between the student lifestyle and how they are being taught in school must be closed. The infiltration of technology in the average U.S. household and in the marketplace has been talked about and at the same time the lack of it in schools has been discussed. The urgency of the seamless technology integration process and how it should be implemented is the question of the hour. The most advanced computers and software, powered with greater connectivity to the Internet, must be made available in schools. An increased awareness among teachers and students related to the potential of computers and instructional computing must be increased to the highest level. The lack of technology integration in schools has to be reduced to the lowest level.

In the 21st century, West Virginia has a new focus for learning. Understanding the importance of integrating technology into the curriculum, in 2005 West Virginia became the second state in the nation to sign an agreement making it a partner with the Partnership for 21st Century Skills (National Education Association, [NEA], 2006). As part of this initiative the West Virginia Department of Education is emphasizing not only the integration of technology but five additional 21st century concepts. These concepts include:

- a focus on core subjects,
- an emphasis on 21st century emerging content areas critical to success in communities and work places,
- 21st century context that creates a balanced education which reflects both national concerns and local needs,

- 21st century technology tools to gain information and communication technology literacy,
- 21st century assessments that measure higher order thinking and reasoning through the use of authentic performance based measures, and
- 21st century learning skills (West Virginia Department of Education, 2006).

This commitment to implementing the Partnership for 21st Century Skills in West Virginia is regarded as the most powerful systemic reform initiative ever undertaken by the West Virginia Department of Education (West Virginia Department of Education, 2006). The learning model is considered to be one that will impact education for 21st century learners across the state. The strength of the Partnership for 21st Century Skills is the projected gain of knowledge and skills of West Virginia's students. With these 21st century skills, these students will be better prepared to make significant contributions to the growth of the state, nation, and world (West Virginia Department of Education, 2006).

To date West Virginia has accomplished more than any other state (North Carolina, Wisconsin, Maine, South Dakota, and Massachusetts) included in the Partnership for 21st Century Skills (K. Kay, public presentation, October, 2007). The state of West Virginia has developed a series of framework documents that describe the culture, practices, and processes of 21st century schools, classrooms, and school districts. Understanding the needs of teaching professionals, the WVDE has also designed supporting materials focused on the urgency for change and outlining the steps necessary to implement the 21st century process.

In early 2007, the WVDE staff, regional agency staff, representatives from all institutions of higher education, and other key professionals participated in nine days of professional development with the purpose of helping stakeholders develop a common understanding and shared vision regarding the Partnership for 21st Century Skills. It is expected that this will lead to West Virginia teachers developing a more focused approach towards 21st century learning and its six components. The professional development occurred periodically over a three-month period with participation from all corners of the state. The WVDE represented by its staff and further supported by regional agency employees discussed the success of the steps of 21st century learning with representatives from all institutions of higher education and other key stakeholders. The professional development revolved around discussions about the changes that are going to be part of the ongoing professional development process and the implications for the stakeholders including personal and organizational changes that are deemed necessary for leading 21st century learning in West Virginia (West Virginia Department of Education, 2006).

The West Virginia Content Standards and Objectives (CSOs) have been revised to meet the standards set by National Assessment of Educational Progress (NAEP), American College Test (ACT), Trends in International Mathematics and Science Study (TIMMS), and the Program for International Student Assessment (PISA) with input being taken from prominent leaders in the field of business, industry, and education under the guidance of the Partnership for 21st Century Skills. The new curriculum standards rubric has been the basis for supporting classroom teachers representing various content areas including reading, English/language arts, science, social studies, and mathematics as they

develop at least four 21st century instructional guides per grade level (West Virginia Department of Education, 2006).

The WVDE has developed the curriculum standards and objectives for core course content for students as well as for those who are involved in the implementation of 21st century learning so that they can gain support in the form of materials to develop learning skills and use of 21st century technology tools. The formation of categories of learning and technology skills as components of the revised content standards was a top priority of the WVDE. Working cooperatively with classroom teachers and higher education representatives, the WVDE facilitated the building of a rigorous, relevant, challenging curriculum that ensures 21st century skills will become part of the instructional focus of every classroom in West Virginia (West Virginia Department of Education, 2006).

The Partnership for 21st Century Skills is intended to develop better citizens who are prepared to function effectively in every situation that they might encounter in a technologically infused environment. The purpose expands further to develop highly educated citizens who can meet the challenges posed by third world countries who are trying to outsource jobs from the United States while depending on a large group of technically literate individuals. Therefore the focus of implementing the Partnership for 21st Century Skills is to generate a very efficient workforce as well as leaders who have not only developed strong academic skills, but thinking, reasoning, and teamwork skills in addition to proficiency in using technology (Partnership for 21st Century Skills, 2006).

> In the U.S. approach, learning skills have often been considered a by-product of effective subject matter teaching. Now they must become the

> intentional and purposeful outcomes of our education system, which will require a significant shift in current pedagogy and assessment strategies. The real economic advances of this century will be made by societies that produce breakthroughs in the teaching and assessing of critical thinking, problem solving, and communications skills. Breakthroughs in our understanding of learning and communications will have an impact not only on the education sector, but also on every other sector of the economy, because they will shape the value added by our workforce to everything from how employees are trained to how products and services are created. (Kay & Honey, 2006, pp. 66-67)

The integration of technology can provide sufficient opportunities to implement 21st century skills and tools in classrooms so content standards and objectives can be easily developed, refined, and changed. Transformation in current educational practices is going to infiltrate schools with extensive technology integration utilizing the best practices that will improve teaching. Utilizing 21st century skills and tools provides meaningful learning opportunities for students. Dillon (2006) refers to Ken Kay, president for the Partnership for 21st Century Skills, who expresses urgency about what needs to be done to create a "world-class education system."

> 'This is urgent, and much of what to do about it is to create a world-class education.' A 21st century world-class education, that is. But despite the name, many 21st century skills are timeless, drawing from the past as much as they draw inspiration from the future. Surprisingly, technology does not occupy the role you'd think it would in today's curriculum. Some

> models barely even mention the word. 'It's not that you need to master technology, but you need to be able to use technology to master those skill sets,' Kay says. '[Technology] is a tool, and tools change. What we're hoping to express is a standard that will resonate over time, so that when we sit down 95 years later, there's not going to be a big hand-wringing over whether these skills are still important.' (Dillon, 2006, p. 2)

There are issues that have to be taken care of before integrating technology into content. "The issue is not simply aiding more students to reach a higher standard of achievement in today's curriculum… such improvements in traditional educational outcomes are inadequate to prepare pupils for 21st-century civilization" (Dede, 2000, p. 281). The main issues are the clear definition of the 21st century skills and tools that are being implemented. The first thing that must be undertaken is to ascertain the level of technology skills so they can be improved to the level that will help in the implementation process. Since teachers are very dependent on the technical support they receive while implementing technology, the important thing is that teachers are provided with sufficient educational preparation, sufficient technical support, and sufficient guidelines for use. "Technology leaders must be able to model the technology" (Bailey, 1996, p. 6), the knowledge of basic technology skills, and the standard of awareness when teachers require technical support (Bailey, 1997).

Since there are considerable benefits of integration of technology in the PK-12 education arena, the same computer-based education techniques can bring about improved results with adult literacy. Computers can successfully facilitate more literate students thereby developing different levels of logical skills and problem-solving

procedures (Askov & Bixler, 1996). It has also been reported that computer use can effectively help in the improvement of academic excellence in a number of areas including that of language and literature with components being reading, vocabulary, language, writing, and listening (Askov & Bixler, 1996; Huss, Lane, & Willets, 1990; Tousignant, 1996).

The world is quickly changing. The emergence of technology as a tool has made the world a fast moving entity economically, technologically, informationally, and politically. There is a massive push in terms of growth due to the basic existence of technology. The way people work and live is being transformed. The changes will continue due to further technological advances throughout the global world in which we live. These changes are basically a continuous upgrading process and the rate of change will also continue to accelerate. The most rapid change will occur in education where the greatest potential for change exists.

> However, technology is not a 'vitamin' whose mere presence in schools catalyzes better educational outcomes; nor are new media just another subject in the curriculum, suited primarily for teaching technical literacy with business applications students may encounter as adults. Instead, emerging interactive media are tools in the service of richer curricula, enhanced pedagogies, more effective organizational structures, stronger links between schools and society, and the empowerment of disenfranchised learners. (Dede, 2000, p. 282)

It is expected that 21st century skills will transform the school and technology integration will occur in such a manner that the technology integrated practices would

appear seamlessly as opposed to added on, very much in the same way as they appear in business, corporations, and government that have incorporated technology. The viability of the current education system is dependent on how well it keeps up with the fast developing world and how well it can use technology for the development and sustainability of 21st century skills.

Schools are expected to prepare all students to have equal access to the latest in this technological world regardless of their economic background. "No longer are educators limited to programs that place drill and practice content in a game format. Nor must they settle for using business applications, which are often ill fit for children's work. Today's educational software applications fill a variety of instructional needs" (Maddin, 2002, p. 11). One example would be to engage students in concept mapping using technology which develops higher order thinking skills. Concept mapping has its beginnings in the constructivist movement. The technique of developing concept maps is quite easy and using this technique, researchers and educators have taken a deep insight into the phases of constructivist learning with individual students (Abrami, 2001; Becker & Ravitz, 1999; Cobb, 1999; Dede, 2000). The use of technology can facilitate better communication thereby ensuring complex problem-solving (Mandinach & Cline, 2000). As a whole, literacy and education in the 21st century are much more than the basic processes of reading, writing, and computing skills. Educational literacy now deals with knowing and analyzing the processes that can ensure a continuous flow of knowledge, its derivation and how the same is being used in the context of a modern life.

It is essential to emphasize various core subjects that would help in building the basic knowledge and skill for the 21st century. As much as students need knowledge in

core subjects, they need to know how to become lifelong learners. In a digital world, students need to know how to use the tools that are essential to everyday work and workplace productivity. Students need to learn academic content through real-world examples, applications, and experiences both inside and outside school. Significant, emerging content areas critical to workplace success include global awareness; financial, economic, and business literacy; and civic literacy. Tests that measure students' performance of the elements of a 21st century education, not only for accountability but for improving teaching and learning must be implemented. The Partnership for 21st Century Skills initiative will ensure participation of each and every child in increasing the level of technology-enhanced education. The teaching process is now emphasizing various learning strategies with students being promoted who have a thorough knowledge of core subjects. Twenty-first century skills assure the development of students to a level of continuous gain and knowledge development (Partnership for 21st Century Skills, 2002).

Problem Statement

Teachers who use computers report using them for planning instruction and locating information for planning lessons rather than for integrating technology into instruction (Becker, 1994; CEO Forum, 2001). In fact, teachers are generally unprepared to meaningfully integrate technology into the curriculum (Cuban, 2001). In educating America's children for a technological world, schools must have the infrastructure in place before technology can be fully integrated into the curriculum. The literature indicates that even when 21st century technology tools are available they are not being used for the kind of teaching and learning that a 21st century context should promote

(Becker, 1998; Becker & Ravitz, 1999). In 2006, Technology Counts ranked West Virginia as the top state in the nation for computer access, technology use, and technology capacity in schools. However, in 2007 (Technology Counts) West Virginia's overall grade fell from "A" to "B" because of its capacity to use technology grade of "C."

The U.S. General's Accounting Office (1995), concerned with whether America's schools have appropriate technologies, such as computers, and the facility infrastructure to support these technologies, conducted a national survey of school facilities. They reported that, overall, the nation's schools were not even close to meeting their basic technology needs. Most schools do not fully use modern technology, and not all students have equal access to facilities that can support education in the 21st century, even those attending school in the same district (U.S. General's Accounting Office, 1995). For West Virginia students to "have a strong grasp of 21st century skills and remain competitive in a 21st century global economy," students and teachers must have access to appropriate technology tools and resources so they can "thrive in the complex life and work environments of the 21st century" (Fadel, as cited by Stansbury, 2007, ¶ 5). In order for West Virginia to meet its goals, we need to know more about the 21st century technology tools available to teachers and how teachers are using technology to create a 21st century context for learning.

Purpose of the Study

The primary focus of this study was to examine the readiness of West Virginia teachers to implement the Partnership for 21st Century Skills initiative at a time when the content standards are being revised and put into effect in 2008-09. The study focused on

two elements of the Partnership for 21st Century Skills: using 21st century technology tools and creating a 21st century context for learning.

Students need to learn to use the tools that are essential to everyday life and workplace productivity. Skilled 21st century citizens should be proficient in ICT (Information and Communication Technologies) literacy, defined as "the interest, attitude and ability of individuals to appropriately use digital technology and communication tools to access, manage, integrate and evaluate information, construct new knowledge, and communicate with others in order to participate effectively in society" (Partnership for 21st Century Skills, 2002, p. 4).

Students need to learn academic content through real-world examples, applications, and experiences. Teachers can create a 21st century context for learning by making content relevant to students' lives, bringing the world into the classroom, taking students out into the world, and creating opportunities for students to interact with others in authentic learning experiences…This provides students the opportunity to see the connection between their schoolwork and their lives outside the classroom. (Partnership for 21st Century Skills, 2002, p. 12)

Research Questions

The following research questions will be addressed through mixed methods:

1. How often are West Virginia PK-12 teachers integrating 21st century technology tools as defined by the Partnership for 21st Century Skills?
2. How often are West Virginia PK-12 teachers integrating 21st century technology tools to create a 21st century context for learning, as defined by the Partnership for 21st Century Skills?

3. What factors influence West Virginia PK-12 teachers' use of 21st century technology tools to create a 21st century context for learning?

Operational Definitions

Operational terms defined for use in this study include:

1. How often – The frequency with which teachers are integrating 21st century technology tools, based on a scale of one to seven (Not at All, Less Than Once a Month, Once a Month, Several Times a Month, Once a Week, Several Times a Week, or Daily) as reported by respondents to the *West Virginia Teachers' Technology Tools and Use Survey* (Appendix A).
2. West Virginia PK-12 Teacher – Refers to teachers in West Virginia public schools who respond to the *West Virginia Teachers' Technology Tools and Use Survey*.
3. 21st Century Technology Tools – [A component of the Partnership for 21st Century Skills] In a digital world, students need to learn to use technology tools to master learning skills that are essential to everyday life and workplace productivity. This proficiency is known as Information and Communications Technology (ICT) literacy. Important 21st century technology tools include information and communication technologies such as computers, networking and other technologies (e.g. probes/sensors and accelerometers, iPods, interactive whiteboards, etc.); audio, video, multimedia and other digital tools; access to online learning communities and resources; aligned digital content software and adequate hardware for all students; and educators with appropriate technology

support systems as identified on the *West Virginia Teachers' Technology Tools and Use Survey*.

4. 21st Century Context – [A component of the Partnership for 21st Century Skills] Students need to learn academic content through real-world examples, applications, and experiences based on authentic projects both inside and outside of school. Teachers can create a 21st century context for learning by making content relevant to students' lives, bringing the world into the classroom, taking students out into the world, and creating opportunities for students to interact with others in authentic learning experiences. This provides students the opportunity to see the connection between their schoolwork and their lives outside the classroom. For example, we need to be able to communicate and collaborate in a modern context using 21st century tools as identified by West Virginia teachers who respond to the *West Virginia Teachers' Technology Tools and Use Survey*.
5. Partnership for 21st Century Skills, to be referred to in the study as The Partnership – The Partnership includes 21 leading advocacy groups, companies, and education organizations who have released a set of principles for guiding redesign initiatives focused on a framework for 21st century learning. The framework outlines the beliefs that are critical to preparing students to be effective citizens in the new global economy.
6. Factors – Refers to supports and barriers influencing the level of effective use of 21st century technology tools for teaching in a 21st century context as identified by West Virginia teachers who respond to the *West Virginia Teachers' Technology Tools and Use Survey*.

7. Influence – Refers to all of the factors that influence or have the potential to influence the effective use of 21st century technology tools for teaching in a 21st century context as identified by West Virginia teachers who respond to the *West Virginia Teachers' Technology Tools and Use Survey*.

Significance of the Study

Results of this study will add to the body of knowledge regarding the frequency of use by educators of 21st century technology tools to teach in a 21st century context. The information generated by this study will provide curriculum specialists and administrators a comparison of their expectations of teacher use of 21st century technology tools in a 21st century context to the reported use. Curriculum specialists can take note of the use or lack of use of 21st century technology tools in a 21st century context and develop strategies for improvement. Administrators can reevaluate their expectations and/or adjust their technology resources and plans for professional development. Knowledge gained from this study may be used to assist in the development or revision of policies that can improve the use of 21st century technology tools in a 21st century context by teachers. The study should provide clear direction for 21st century instruction across the state.

By studying the frequency with which teachers are integrating 21st century technology tools in a 21st century context, data will be generated that can be used to create new strategies for training current and future teachers. The factors influencing teachers' use of 21st century technology tools to create a 21st century context for learning identified by this study may benefit West Virginia legislative policymakers; higher education faculty and administrators as they develop programs of study. The study will provide important data to state, regional, and local level professional development staff as

they design effective professional development. The teachers' responses will provide information for administrators to consider as they purchase technology and evaluate its use.

This study might be used by education policymakers to evaluate the existing standards, curricula, and assessment and refine them to make sure they address the latest demands for 21st century skills. The findings will allow legislative policymakers and state and district administrators to prioritize funding for professional development in order to provide teachers with appropriate pedagogical strategies that will enable them to overcome barriers that prohibit the integration of technology. The study will provide policymakers with data to support possible employment of Technology Integration Specialists in all districts to support teachers as they integrate technology into the curriculum and model best practices identified by the research. This will enable West Virginia to create a lasting legacy of educational achievement and fulfill the obligation to future generations of students, citizens, and workers. The results of this study could assist with the development of new and/or revised policies of expected 21st century tool use in a 21st century context for teachers and students.

Limitations of the Study

Even though 21st century skills, as identified by the Partnership for 21st Century Skills, include six components, this study focuses on two: 21st century technology tools and creating a 21st century context for learning. The study is based on a sample of West Virginia teachers and is not intended to be applied outside West Virginia. Surveys of teachers in other states or school districts with different levels of access to 21st century technology tools and context may produce different results.

The fact that the survey results are based on self-reported data is another limitation. Self-reported data are sometimes unreliable and tend to be upwardly biased in the direction of over-reporting the actual amount of use. One might predict that those teachers who voluntarily responded to the survey may be perhaps more interested in 21st century technology tools and context than those teachers who did not respond.

Summary of the Research

Chapter One is an introduction to the research. Chapter Two provides a review of the professional literature related to the research. Chapter Three outlines the methods used in conducting the research. It includes the research design, the population and sample, instrumentation, data collection and analysis procedures. Chapter Four includes the research findings. The data is presented and analyzed statistically for each research question and ancillary findings are presented. Chapter Five contains a summary of the work and the conclusions of the researcher.

CHAPTER TWO: LITERATURE REVIEW

Humans, being the most intelligent creation of nature, have a tendency to explore and derive knowledge from everything that forms a part of their existence including healthy survival and secure development. The very nature of man can be understood by what Christopher Columbus and Vasco de Gamma did. To search for new places and routes of business they explored the sea. Similarly, the intriguing behavior of natural things like the sun, the moon, the stars, and the earth, are all matters of interest and continuous research. To quench this thirst for knowledge and information, man has continued his efforts for centuries to develop the required technology to overcome obstacles. To move across the sea, man built the ship. To explore the sky he developed the airplane. To know the mysteries of the universe, spacecrafts were designed. Hence, the factors that affect the way people live have seen dramatic influence from all corners of the world due to the permeation of technology into every aspect of life. Some of the important factors influencing today's modern society and transforming the way we live are economy, both local and global; technology, including computers and the Internet; information, with a plethora of knowledge of demographic and social surroundings; and finally political force and type of government (Partnership for 21st Century Skills, 2006). The way humans interact with nature and its surroundings have made it possible for man to understand the world he lives in and harness what he needs for his own use.

The advent of technology has transformed society. The very way we live and how we understand the world we live in has changed. This review of the literature discloses that technology is not only changing the way people work and play, but it is changing the roles of teachers and learners in the classroom. Because of the emergence of new

technology there arises a need for change in instruction. Examining the frequency with which West Virginia teachers integrate 21st century technology tools, the frequency with which West Virginia teachers teach in a 21st century context, and the factors related to their instructional technology practices is the focus of this study. Significant research suggests that technology, when integrated effectively, will improve the quality of education (USDOE, 2003). However, technology is not a remedy for the problems that exist in education today.

> Technology alone will not improve the quality of education, but when integrated with curriculum and instruction; it can be a powerful educational tool. Technology that is fitted to curriculum and instruction can stimulate the development of higher-order thinking and problem-solving skills, and it can support collaborative, globalized learning. (Reed & McNergney, 2000, p. 1)

At the conclusion of the ten year long "Apple Classroom of Tomorrow" (ACOT) project, which set out to investigate how technology use by teachers and students would affect teaching and learning, Sandholtz, Ringstaff, and Dwyer (1997) offered guiding principles to teachers and schools. One of the "core principles" from this study is that "technology is most powerfully used as a new tool to support student inquiry, composition, collaboration, and communication" (p. 183). They also concluded that, "To those [educators] looking for a powerful tool to support collaborative learning environments, technology holds tremendous potential" (p. 184). In brief "technology in and of itself will not change education; what matters is how it is used" (p. 10).

This chapter documents selected findings in literature related to the following eight areas. The first section explains the role of technology in today's society. Section two discusses the International Society for Technology in Education (ISTE) standards and how they relate to the West Virginia Technology standards. The third section describes the partnership West Virginia has developed with Partnership for 21st Century Skills and how they plan to carry out the implementation of the 21st century skills initiative. The fourth section explores literature on the critical elements for creating 21st century skills. Section five documents selected findings in the literature on technology, education, and integration. Section six investigates different views on research for school technology leaders and their vision of 21st century skills. The seventh section provides an overview of technology and constructivism. Finally, factors related to the need for change are discussed in the eighth section of the literature review.

Role of Technology in Today's Society

Crawford, Bodine, and Hoglund (1993) believe technology is important in the education world because it is relevant in society. However, technology is not a not a 'cure-all' whose meager presence in schools accelerates better educational outcomes; nor are new media just another subject in the curriculum, suited mainly for teaching technical literacy with business applications that students may encounter in society as adults. Instead, emerging interactive media are tools needed to overhaul richer curricula, enhanced pedagogies, more effective organizational structures, stronger links between schools and society, and the empowerment of deprived learners (Trotter, 1997). Therefore school districts should be preparing individuals for their roles in society through technology integration.

How Technology Has Changed the World

The advent of technology and computers has changed the way the world works. Distance is no longer a differentiating factor and a matter of concern. In a physical sense the world might appear an enormous place with businesses at distant points, but the world in virtual form does not depend on distance. Business can be transacted within minutes, if not seconds. The technology behind this mega change is based on the computer and is defined as information technology (Becker, 2000b). This technology has led to the creation of a cyber world, or electronically generated world, with the help of computers connected to each other through suitable wires or in some cases wireless and is the driving force of our economy. Today words like cybercafé, cyber chat, cyberspace, and cyber shopping are common. People can send electronic mail to distant places within seconds. In today's "flat" world people in Shanghai and New York are no longer isolated due to distance; they are connected electronically and are just seconds away with the ability to share knowledge instantly (Friedman, 2006).

Transferring data in electronic form is actually the fastest way to transfer information in today's world. It is not only data transfer that has been revolutionized but also the business world. In *The Future of Work,* Thomas Malone (2004) of M.I.T. argues that recent technological advances are bringing about changes in business organizations that will be as dramatic as the rise of democracy was to government. There are virtual shopping malls with websites offering a variety of products ranging from computer peripherals to groceries and 21st century students feel right at home in this world. Tanenbaum (2003) proclaims that "computer networks" with the capability of bringing shopping to the consumer's home or office, "may become hugely important to people

who are geographically challenged, giving them the same access to services as people living in the middle of a big city" (p. 9).

Companies are now providing details of their products through websites and are accepting customers' requests for information in addition to accepting orders for products. Most anything one wants is available online. Money transfer can easily be completed electronically. People do not have to wait long for information or product delivery. It is the information which rules the world. Typically, in the real world, information is sent and received. In the virtual world, residents can do things that are nearly impossible in the real world. "Teachers of architecture bring their students to SL [Second Life] to build things that would either be too expensive or physically impossible to create in the real world" (Lamb, 2006). John Lester, communication and education manager at Linden Labs says, "The students can see each other while they're building and work collaboratively around projects" (Lester, as cited by Lamb, 2006, ¶ 16). This high performing virtual world has made significant change in performance within the real world (Tanenbaum, 2003). Some things in the real world are now easier to comprehend because of customizable simulation software. Outsourcing has helped to access low cost labor in far off Asian nations like India and China. Multinational companies like Microsoft, IBM, GM, and GE have offices in almost every part of the world and performance of each of these units can be monitored from any of its offices. Offices have been networked though Local Area Networks (LAN) and Wide Area Networks (WAN). These companies have virtually made themselves available to their customers anytime, anywhere, and just a click away (Tanenbaum, 2003).

A child in the 21st century is born into an environment where digital electronics rule, and it would be very complicated for this child to comprehend the fact that a century ago it was difficult to even call a place nearby. Everyday tasks were mostly mechanical and analytical. The world was an enormous place, large enough to consider each of the nations as islands of culture with little interference from other cultures. Now, the world has become very small with information from distant places available at the click of a mouse. Websites are the second address of everything that has dual presence, both physical as well as virtual. Even though there is the same physical distance, virtually all are sitting together and are available at virtual locations. These changes and the rate at which these changes are being incorporated into society are going to continue and as a result everything that sees the integration of technology will accelerate (Millett, 2002).

Students and educators can work together in Second Life from anywhere in the world as part of a globally networked virtual classroom environment. This engaging multi-user virtual environment (MUVE) can exist as a business group, a community, or a simple family and supports the educational process (Schrock, 2008). The matter of importance is the individual's capability to adapt to changing conditions not only to thrive but to achieve further success. According to the website,

> Second Life provides an opportunity to use simulation in a safe environment to enhance experiential learning, allowing individuals to practice skills, try new ideas, and learn from their mistakes. The ability to prepare for similar real-world experiences by using Second Life as a simulation has unlimited potential! (Linden Research, Inc., 2007, ¶ 9)

Technology Integration

Developed nations have always been responsible for beginning any revolutionary change in technology, in education, and in implementing technology integration into the educational process by "leading the way to this transformation and changing the landscape of education in the process by eliminating the artificial lines and boundaries created by traditional teaching tools and techniques" (Merkow, 2002, ¶ 1). The United States of America has been one of the most developed nations of the world right from the beginning of the 20th century (Cooley, 1999). Technology in the United States is not a gadget but a lifestyle, and the nation is going to have a new era when the entire educational process seamlessly integrates technology as it is integrated in everyday life. Beginning with this integration is the most important part of school reform (Best, 2002). Any such initiative should ensure the application of meaningful steps and processes that will provide a significant and ambitious thrust to the future careers of all students in the form of knowledge and skills that will help them in preparing for a successful future.

Li's (2007) survey of 15 math and science teachers and 450 secondary students regarding their views of technology integration in schools revealed that

> Most teachers perceive technology integration as no more than an extra workload on both teachers and students, with little educational value for the time and effort invested. Their students, on the other hand, enthusiastically embrace technology and call for frequent and better use of it in schools. These results confirm Guerrero, Walker, & Dugdale's work (2004) that teachers' attitude towards technology tends to be negative, while student attitudes can be summarized as enthusiastic. (p. 391-392)

Bailey and Pownell (1998) compared technology integration to *Maslow's Hierarchy of Needs* and stated that there are 11 conditions that should be considered when technology is effectively integrated: change, planning, ethics, teaching and learning, safety, security, curriculum, professional development, technical support, infrastructure, and leadership. These conditions definitely influence the use of technology in the educational setting. Parr (1999) found that the implementation of technology integration should be incremental and teachers need help connecting the technological and pedagogical knowledge.

21st Century Skills Challenge

Twenty-first century skills have become an urgent issue due to rising intellectual and technical capacity of the students and workforce outside the U.S., especially in third world countries which include India and China. This has had a serious effect on the competitiveness of the U.S. with falling values on indices of industrial, as well as technical, parameters. The challenge encountered by outsourcing has actually been the gravest one the nation as a whole has faced since the end of the cold war era. The initiatives which have been taken up recently by departments of the U.S. government under the umbrella of the U.S. Department of Education have focused their attention on high schools across the country. Along with several non-government as well as neo-political bodies, agencies have cited the urgency in providing an overhaul to the entire educational system in order to keep up with the Information Age.

Prior to the Information Age, students could find employment that did not require high levels of math or reading; in the Digital Age the lack of a high school diploma increased the odds of a life associated with poverty and other social problems (Barrios,

2004). Modern-day students in the United States are considered "Digital Natives" who think and speak the digital language of video games, computers, technology, and the Internet (Prensky, 2001). These Digital Natives represent approximately 100 million students born between 1976 and 2008 who have grown up with the Internet and an understanding and reliance on digital technologies.

> According to the United States Department of Education, 90% of children between the ages of 5–17 use computers and more than 90% of students in the 12–18 age group use the Internet. These students are readers and enjoy a learning environment that includes teamwork, technology, multiple focal points, action and interaction, movement, and materials that are visual and dynamic. "Millennials" expect to receive frequent and instantaneous feedback and to learn skills and concepts that will help make their working lives less stressful and increase their marketability (Gleeson, 2003).

Content must be taught in a 21st century context with the use of relevant and real world examples, applications, and settings to frame academic content for students, enabling them to see the connections between their studies and the world in which they live (Partnership for 21st Century Skills, 2002). Revised school curriculum in West Virginia now offers meaningful, relevant content integrated with 21st century skills. Generally, these 21st century skills are identified as information and communication skills, thinking and problem-solving skills, and interpersonal and self-directional skills (Partnership for 21st Century Skills, 2002). In December 2005, the West Virginia Board of Education formed a partnership to look into the future needs of West Virginia schools for the implementation of 21st century skills (Technology for 21st Century Learners,

2006). At the same time, the Partnership for 21st Century Skills supported redesigning components of the educational process with activities being undertaken while anticipating the 21st century knowledge and skills made available to all students striving for success. The needs of students entering the workforce go beyond the basics. The 21st century skills implementation will ensure the easiest transformation for today's students to live and work in an ever-changing society (Barrios, 2004). The American high school of the future needs to be designed to meet all potential challenges and be suitably organized for the implementation of 21st century learning and achievement (Partnership for 21st Century Skills, 2006).

Birth of Partnership for 21st Century Skills Organization

The Partnership for 21st Century Skills including various government and non-government as well as political organizations was brought into existence to develop a unified and collective vision for 21st century learning. The sole motive has been to strengthen the foundation of American high schools with a 21st century vision and to make education in the United States comparable to that at the international level (Partnership for 21st Century Skills, 2006). This vision has been developed after ensuring sustained, comprehensive efforts applied to produce a mutually inclusive understanding and generation of common terms and language for education in the 21st century. The Partnership has conducted extensive research on 21st century skills through collaboration with different groups for documenting the vision, its purpose, the methods of implementation and future transformations. The research process has targeted every class of educators, employers, parents, community members and students to draft the vision of the Partnership Program. The Partnership for 21st Century Skills sponsors various yearly

forums and summits designed to ensure regular phases of refinement to address present and future challenges. The Partnership for 21st Century Skills seeks support from every citizen and stakeholder across the nation in the course of refining this multiyear process. There has been extensive foundational support for integrating 21st century skills into education (Partnership for 21st Century Skills, 2006). In order to accomplish the vision of The Partnership, the International Society for Technology in Education (ISTE) advocates "efforts that extend beyond giving technology to students. The impact of our work ensures that technology empowers educators to help more students achieve their full potential" (ISTE, 2008, ¶ 9).

ISTE Standards and West Virginia Technology Standards

In 1993, the International Society for Technology in Education (ISTE) began the process of designing National Educational Technology Standards (NETS) for Teachers (NETS•T). The original list included 13 indicators. In 1997, these technology standards were revised to include an additional five indicators and were organized into three categories: basic computer/technology operations and concepts, personal and professional use of technology, and application of technology in instruction. The first edition offered guidelines for how technology should be used throughout the curriculum, benchmarks for teacher and support staff technology competencies, and standards for the assessment of technology use. The third edition of the NETS for Teachers (NETS•T): *National Education Technology Standards for Teachers: Preparing Teachers to Use Technology* (ISTE, 2002) contains six expanded categories that promote "planning, implementing, assessing, while adding a category on social, ethical, legal, and human issues related to technology use" (p. l8). This publication lists 10 "essential conditions" (p. 18) that must

be in place to support effective use of technology to improve learning, communication, and productivity: (1) shared vision, (2) skilled educators, (3) technical assistance, (4) student-centered teaching, (5) community support, (6) access, (7) professional development, (8) content standards and curriculum resources, (9) assessment, and (10) support policies. This new document focuses on how teacher educators can integrate the effective use of technology into the lessons they plan for training novice and in-service teachers (ISTE, 2002).

There are currently three sets of ISTE standards, including standards for students (NETS•S), teachers (NETS•T), and most recently school administrators (NETS•A). The ISTE NETS•T help guide the preparation of pre-service teachers and professional development for in-service teachers. The NETS•T are divided into six broad standards:

1. Technology Operations and Concepts
2. Planning and Designing Learning Environments and Experiences
3. Teaching, Learning, and the Curriculum
4. Assessment and Evaluation
5. Productivity and Professional Practice
6. Social, Ethical, Legal and Human Issues

Within each of these broad standards are more specific standards. For example, under Standard 3: Teaching, Learning, and the Curriculum, teachers are challenged to use technology to support strategies that are learner-centered and address the diverse needs of students. These standards are focused not just on using technology tools, but on issues related to their integration in the classroom (ISTE, 2002).

ISTE is scheduled to release the fourth edition of NETS•T in 2008 after they complete a "year-long process of revisions by seeking input and feedback from educators, leaders, and the private sector" (ISTE, 2007,¶ 2). At the annual conference, Don Knezek, ISTE CEO, said:

> Leadership in technology is best illustrated by ISTE's creation of the National Educational Technology Standards (NETS), first published in 1998. ISTE is now leading the creation of the next generation of NETS. In 1998, it was enough to define what students needed to know about and be able to do with technology. Now, we're defining what students need to know and be able to do with technology to learn effectively and live productively in a rapidly changing digital world. (¶ 3)

Educational leaders should always be a part of the solution rather than the problem when integrating technology. The common notion is that principals without the knowledge of basic technology skills are more of an obstacle to any technology integration initiative either in the present or the future. The principal can provide efficient leadership by becoming aware of basic technology skills and approaching change from the human perspective responsive to teacher's needs (Bolman & Deal, 2002). The school's technology leader must create a vision and then share and implement the vision by seeking proper funding (Bolman & Deal, 2002). Planning the process of implementation requires proper coordination from administrators so that curriculum development and training can be undertaken by teachers.

History of ISTE Standards – NETS•T

NETS•T focus on how teachers develop higher-order thinking, support constructive learning activities, and manage technology use in the classroom. They provide a clear statement and parameters that help in analyzing and measuring the standards and performance indicators that teachers should be prepared to meet so that technology can easily be integrated into the curriculum. The ISTE standards for teachers are based on four levels of technology performance: (1) novice, (2) developing, (3) approaching, and (4) proficient (Learning Point Associates, 2005).

The technology performance levels provide ample guidance so that efforts in attaining basic technological skills and sufficient competency over the required knowledge base will produce desirable results. Bowman, Newman, and Masterson (2001) found that "if teachers are provided with extended and continuous support and training, then diffusion of educational technology in school districts will be successful" (p. 92). Acquaintance with the issues of technology implementation barriers and supports surrounding technology performance levels of teachers and the effect of technological standards actually gives an in depth view of a very basic platform over which administrators' knowledge stands (Bowman, Newman, & Masterson, 2001).

The knowledge and understanding of technology by the administrator is perhaps the most important factor that determines whether or not the assimilation of education and technology will work with teachers and students in the classroom (Hughes & Zachariah, 2001). Teachers and administrators who have sound technology principles are more comfortable with the youth of today who are tech savvy users of electronic equipment. Administrators, who are aware that the effectiveness of technology

integration is a variable depending on teachers' competencies, can optimize technology use in their schools. The most important way administrators can promote technology use is to be knowledgeable and effective users of technology themselves (Anderson & Dexter, 2005; Baylor & Ritchie, 2002; Dawson & Rakes, 2003). The development of these specific and well-researched competencies helps in providing proper guidelines for establishing steps for the administrator to maintain technology leadership, therefore his assistance in technology integration in schools will result in far reaching outputs in technology literacy and enhanced student learning (Blasé & Blasé, 2000).

The educators' perception of technology leadership competencies is an important factor behind the successful integration of technology ensuring a rather smooth flow of knowledge and information (Chin & Hortin, 1994). Teacher technology leaders, often media center specialists, improve classroom practice by engaging other teachers in critical reflection on their experiences and sharing classroom experiences with other teachers in formal and informal ways (Darling-Hammond & Ball, 1997; Lieberman, 1995; Little, 1994; Loucks-Horsley, Hewson, Love, & Stiles, 1998).

Technology Integration and Best Practices

In a case study, Ertmer, Addison, Lane, Ross, and Woods (1999) examined the beliefs and teaching strategies of 17 teachers perceived as exemplary technology users by peers and administration. Their study identified distinguishable characteristics between technology-using teachers and those who integrate technology: "Technology-using teachers tend to be identified relative to what others are doing around them, perhaps placing an unnecessary emphasis on teachers who use technology as opposed to teachers who use it to support best practice" (p. 71).

Ertmer, Gopalakrishnan, and Ross (2001) concluded "Our results suggest that although constructivist practices do not depend on the use of technology, technology may support and facilitate these practices" (p. 2). The most common mutual belief among this group of teachers was that "technology provided a valuable tool for achieving their visions of teaching and learning" (p. 6). Supporting constructivist philosophy did not always transform into structured teaching practices. "Given that visions precede practice, it is possible that these teachers will, in time, translate more of their ideas into practice" (p. 6).

The study by Ertmer, et al. (2001) discovered that teachers' beliefs resulted in best practices that promote student-centered and student-directed learning. These results verified Riel and Becker's (2000) prediction that technology-using teachers would use constructivist teaching practices more often than teacher-directed instruction that does not facilitate students in charge of their own learning. "The results of this study suggest that exemplary technology use does not readily align with current descriptions of best practices; rather, it illustrates what happens when visions meet reality in today's K-12 classrooms" (Ertmer, et al., 2001, p. 5). Numerous factors affect the integration of technology into classrooms including not enough computers or not using computers for delivering instruction (Smerdon, Cronen, Lanahan, Anderson, Iannotti, & Angeles, 2000). If schools are going to prepare students to succeed in the 21st century workforce their technology plans need to ensure technology integration into the curriculum.

West Virginia Department of Education Technology Plan

The WVDE has its own Strategic Work Plan for implementation of Educational Technology for 21st Century Learners. The organization is fully committed to cooperate

and work with other organizations, stakeholders, and partners involved with The Partnership (West Virginia Department of Education, 2006). Other organizations which are working with WVDE are the Center for Professional Development (CPD), Higher Education Policy Commission (HEPC), Governor's Office of Technology (GOT), Regional Education Service Agencies (RESAs), County Boards of Education, The Edventure Group, AEL/Edvantia, higher education institutions, business/industry, and the community to maximize efficiency of effort and resources (West Virginia Board of Education, 2007).

WVDE also requires strategies for analyzing fundamental ingredients like the equipment, infrastructure, software, professional development, and technical assistance, which are basic requirements for various essential elements of 21st century learning as identified by The Partnership. It also identifies areas which are in urgent need of attention to produce 21st century learners including: 1) providing adequate technology needed to provide students access to high quality instruction, 2) increasing bandwidth to ensure equitable availability, and 3) equipment and network upgrades to industry standards (West Virginia Board of Education, 2007).

The Comprehensive Report of Findings and Recommendations (CRFR) which is a detailed outcome of the Strategic Work Plan of various agencies of the West Virginia Department of Education, was made available to the West Virginia Board of Education in May 2006. The recommendations of this report were to be incorporated into the 5-year Strategic Work Plan of West Virginia's school systems. This 5-year plan includes the systems' Educational Technology Plan and is updated yearly. The guidelines of the federal as well as the state government will be the desirable format according to which

the revisions of the Strategic Work Plan will be made and submitted yearly to the West Virginia Board of Education (West Virginia Board of Education, 2007).

The West Virginia Board of Education has been charged by the state government to provide all children equal opportunity to education and learning. The board is responsible for maintaining the quality and efficiency of education and associated systems. Therefore, it is important for the CRFR to contain all necessary guidelines and lines of action to ensure that all details of the programs, related services, and trained workforce and staff are in accordance with the best possible data and empirical evidence (West Virginia Board of Education, 2007). The plan needs to be thorough and should clearly define all basic areas of need and change. Hence, this strategic work plan has been devised to create a set of processes that would address all areas of need (West Virginia Board of Education, 2007).

West Virginia State Board Policy has mandated the development of 21st Century Learning Skills and Technology Tools Content Standards and Objectives for West Virginia Schools that will be effective in July, 2008. The Strategic Work Plan and the Comprehensive Report of Findings are intended for providing a 21st century education and identifying the skills essential for PK-12 students in West Virginia "for future success in the workplace and further education" (West Virginia Board of Education, 2007, Section 4).

The tasks which are outlined in the WVDE Strategic Technology Work Plan are: (1) provide students and staff with equitable access to technology infrastructure which has been developed to support acquisition of 21st century skills; (2) provide students equitable access to curriculum and related instruction offerings through the use of

technology; (3) provide online professional development offerings to enhance the number of highly qualified teachers and National Board Certified Teachers (NBCT); (4) maintain a current and comprehensive statewide management and information system; (5) research the extent of integration of technology in the teacher preparation programs within West Virginia higher education teacher preparation courses; (6) explore technology integration competency requirements that are incorporated into teacher preparation programs for all new teachers; (7) provide all educators with an online professional development program that provides an orientation to the five content and skill areas that represent the essential knowledge for 21st Century instruction; (8) design a technology literacy skills self-assessment available for all educators to support 21st century instruction; (9) provide schools with access to Technology Integration Specialists; (10) determine the design and feasibility of an 8th grade assessment of technology skills; and (11) provide software that supports basic skills acquisition and aligns with the West Virginia CSOs (West Virginia Board of Education, 2007).

Partnership for 21st Century Skills

The Partnership for 21st Century Skills has been evolving continuously and has now moved from documentation to definition and measurement of various skills crucial to initiatives beginning with customization of the framework and state educational requirements (Trends, 2006). West Virginia, being one of the first two states to incorporate the Partnership for 21st Century Skills Framework into their education program, has now extended its focus to helping counties and districts develop their infrastructure and learning plans in accordance with the framework provided by The Partnership.

The complete revision of the West Virginia Department of Education's *Educational Technology Plan* is to be undertaken according to the Strategic Work Plan that guided the development of the Comprehensive Report of Findings. The Comprehensive Report of Findings, a blueprint for the educational technology plan, was completed with detailed input provided by various organizations in West Virginia (West Virginia Department of Education, 2006). These five organizations are:

1. West Virginia Department of Education (WVDE)
2. West Virginia Legislature
3. United States Department of Education (USDE)
4. Federal Communications Commission (FCC)
5. West Virginia Governor's Advisory Council on Educational Technology (GACT)

Each of these organizations has a definite work plan which they will strategically incorporate for developing various school improvement pillars (curriculum; instruction; school effectiveness; and student, family, and community support) of the implementation process of the Partnership for 21st Century Skills initiative.

West Virginia and the Implementation of 21st Century Skills

The world and the economy in the 21st century will certainly be different from anything that has been observed until now. This change has raised concerns to a considerable level in the United States of America. The main issues have been the challenges that the country will have to face in reforming the nation's education system. The areas of reform include the program of study as well as the way the education and knowledge have to be delivered. As long ago as 1990, the Mathematical Sciences Board recommended that the current instructional system in the United States was ineffective in

delivering quality education to the students and needed to be phased out (National Research Council, 1997). The Third International Mathematics and Science Study (TIMSS), in its comparison of mathematics and science achievement since 1993, revealed that performance in technical subjects by students with science and mathematics as majors continues to decline. The poor performance is visible when test scores of students in the United States are compared with students from Europe and Asia (Bailey, 1997).

The TIMMS findings that U.S. students are not doing as well as others on international tests have led to a closer look at the many disciplines that come within the scope of public education. The proposed reform process is being generalized to undertake various levels of reforms with educators and administrators searching for new ways to improve education (Strassenburg, 1996). The use of technology, especially the computer, has been promoted and educators are to be prepared to effectively integrate technology into the curriculum. The proposed changes are intended to provide similar educational opportunities to students to help in enhancing each student's performance (Picciano, 1994).

Understanding the importance of new technology implementation for the development of education in the state, in 2005 West Virginia State Superintendent Steve Paine made a revolutionary decision by joining the Partnership for 21st Century Skills. The reason behind this quick change of policy was West Virginia's much lower results on the National Assessment of Educational Progress (NAEP). The need of the hour has been the implementation of tools that will enable West Virginia students to master a broad

range of skills that, in the long run, will make them competent and give advantage over students of other states and also the world around (Henke, 2007).

Traditional Curriculum vs. Digital Curriculum

The existing curriculum has been modified by integrating digital technology with traditional education tools and critical 21st century skills. The curriculum resources for 21st century students have been designed online for various levels of instruction across West Virginia; now it is a matter of assessment on parameters like instructional design modules and the possibility of successful implementation. The various Content Standards and Objectives (CSOs) related to instruction have been revised to include 21st century learning skills, 21st century technology tools and 21st century content. The assessment process has been developed around the 21st century CSOs thereby making the assessment process more rigorous than the previous one (Henke, 2007).

Incorporation of Information and Communication Technology (ICT) literacy into lesson design at various levels has been completed with intensive content revision, the final aim being the improvement of learning skills (Henke, 2007). The International Society for Technology in Education's National Educational Technology Standards for Students (NETS•S) are a set of guidelines for enabling ICT literacy and the extent and level of integration of the same with the current education system. The Partnership's 21st Century Learning Framework gives the direction of implementation suggesting the flow of strategies for multiple usages of ICT, for example using digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society, and associated technology for enabling better education at all levels (Henke, 2007).

Revision of Curriculum

The revision of curriculum was undertaken by committees of educators across West Virginia and now enables a focused approach and thoroughly defined tasks for better performance. The goal of the committee was to "build a rigorous, relevant, and challenging learning skills curriculum that would prepare students for the 21st century" (West Virginia Board of Education, 2007, p. 4). West Virginia educators were instrumental in shaping the content standards to "align with national standards, rigorous national assessments and research and best practice in the field of educational technology" (p. 4). The professionals involved in the curriculum revision included regular classroom teachers, special education teachers, and representatives of higher education. This well-rounded group contributed to a quality document that is in a format easy to follow by West Virginia educators.

The current phase of the education reform is to bring West Virginia teachers into the fold of the Partnership for 21st Century Skills initiative (West Virginia Department of Education, 2006). The resources developed under the guidance of West Virginia teachers are available at Teach 21, a website designed to assist colleagues in planning and delivering effective 21st century instruction. Currently math, social studies, science, reading, and English plans are available at various grade levels. The site enables educators to quickly access 21st Century content standards, learning skills, and technology tools including training materials that contain introductory pieces on 21st century education and issues, videos from across West Virginia of exemplary 21st century teachers, a blog, a wiki, and links and references to other useful sites, as well as other resources that exemplify "rigorous and relevant instructional design and delivery" (West

Virginia Department of Education, 2007, ¶ 1) for West Virginia. All four components of technology implementation and how they can be integrated to develop skills are included in the instructional designs. Success of students with the knowledge of these skills will be a definable moment for this integration process and the students will then be equipped with up to date knowledge and advanced creativity for the acquisition of more skills. The new curriculum and standards will be a part of the education system beginning with the year 2009 (Henke, 2007). By "taking the first steps toward integrating 21st century skills [West Virginia] represents the pioneers in the next wave of education reform (¶ 31).

Critical Elements for Creating 21st Century Skills

Extensive research by The Partnership has led to six critical elements for learning in the 21st century. The six elements (Partnership for 21st Century Skills, 2002) are as follows:

1. *Core Subjects* - identifying all elementary subjects like "English, reading or language arts; mathematics; science; foreign languages; civics; government; economics; arts; history; and geography." (p. 8)
2. *21st Century Content* - depicting several significant emerging content areas which are critical to achieving success in communities and workplaces that most of the time do not fall under the category of core subjects. Some of the subjects falling under this category are "global awareness; financial, economic, and business literacy; civic literacy." (pp. 12-13)
3. *21st Century Learning Skills* - Learning and thinking skills are expected to contain non-academic content but are supposed to be equally important with contributions to the development of critical and analytical thinking with input of creativity and

innovation including an emphasis on "information and communication skills, thinking and problem-solving skills, and interpersonal and self-directional skills." (p. 9)

4. *21st Century Technology Tools* - Information and Communication Technology (ICT) literacy means using technology to perform learning skills. Current technology includes computers, networking and other equipment, plus audio, video, and other media and multimedia tools which can contribute to learning content and perfecting skills.
5. *21st Century Context* – Because the world children live in presents opportunities where they are faced with vast opportunities involving complex choices, helping them make practical connections are critical. Teachers can create a 21st century context for learning by making content relevant to students' lives; bringing the world into the classroom; takings students out into the world; and creating opportunities to interact with others in authentic learning experiences.
6. *21st Century Assessments* - 21st century assessments provide a tool to measure the other five elements to ensure intended outcomes of the elements of the 21st century skills envisioned by the Partnership for 21st Century Skills research.

Of the above mentioned six elements of 21st century learning, two are the focus of this study; 21st century technology tools and teaching and learning in a 21st century context.

21st Century Technology Tools

Use of 21st century tools will ensure up to date development of learning skills (Abrami, 2001; Jonassen, Peck, & Wilson, 1999; Kay & Honey, 2006). The use of different electronic equipment will keep the development of learning tools in accordance

with the requirements of the digital world in which students reside. Living in such an environment has amplified the need for learning different techniques that will help in the use and reuse of tools irrespective of being analytical or digital but that are essential to everyday life and to increasing workplace productivity (Conyers, Kappel, & Rooney, 1999). The citizen who has acquired the skills of a 21st century learner would be expected to be proficient in technology related to ICT and using "modern tools to teach and assess them [ICT Literacy Skills] is a new approach" (Partnership for 21st Century Skills, 2002, p. 13).

The digital technology and communication tools have to be used to achieve various tasks which will cause further improvement in the tool itself. ICT literacy will ensure proper access and information management. It will make way for integration, information evaluation, construction, and then communication of new knowledge with others in order to create new waves of effective participation (Askov & Bixler, 1996).

A 2003 study conducted by Barron, Kemker, Harmes, and Kalaydjian provides data that indicate many teachers are implementing technology as a tool for research, communication, productivity, and problem solving; however, the goal of technology integration across all subject areas and grade levels has not yet been reached. Barron, et al. found that the proportion of teachers using computers as a tool in the classroom ranged from 20% (problem-solving tool in high schools) to 59% (communication tool in elementary schools). Across subject areas, the range was 10% (problem-solving tool in English) to 59% (communication tool in science).

Becker and Riel (2000) examined whether the professional engagement of teachers correlated with a specific philosophy, with types of instructional practices linked

to philosophies, and with frequency and type of computer use. They discovered that Teacher Leaders (teachers who are leaders in their communities):

> Use of computers with students is not limited to gaining computer competence, but extends to involvement in cognitively challenging tasks where computers are tools used to achieve greater outcomes of students communicating, thinking, producing, and presenting their ideas. Data on software use and objectives for computer use suggest that Teacher Leaders recognize the features of technology that grant students access to a broader community and knowledge base beyond the walls of the classroom. They are able to incorporate the use of computers into student activity more effectively than teachers who fail to participate in their professional community. (p. 35)

Becker and Riel (2000) in their analysis of the data collected from the Teaching, Learning, and Computing (TLC) survey, a national survey of more than 4,000 teachers from grades 4-12 conducted in Spring, 1998, under a grant from the National Science Foundation found that the functionality of computers "remain quite different for teachers of different subjects, teachers who teach students of different ages and backgrounds, and teachers who have characteristically different pedagogies" (p. 2). The survey revealed that software applications more likely to be used by teachers knowledgeable in the use of computers included presentation software, World Wide Web browsers, electronic mail, spreadsheets and database software, and multimedia authoring software in English, social studies and elementary classes.

Teachers are much more constructivist in philosophy than they typically are in actual practice, possibly as the result of the many difficulties involved in doing constructivist sorts of things; for example, having students' interests affect the topics of their classwork, orchestrating classes so that multiple activities can occur simultaneously, or having students do serious group work including engaging one another in authentic exchanges of ideas and opinions (Ravitz, Becker, & Wong, 2000). Sustained and thoughtful use of computers as learning resources should actually help teachers implement a teaching practice that promotes teaching and learning in a 21st century context.

Teaching and Learning in a 21st Century Context

Teachers must make content relevant to students' lives by framing academic content with examples, applications, and settings from the communities where students live. Outside experts from the community can be brought into the classroom by using technology. This effort to expand the classroom not only brings the world into the classroom but also takes students out into the world via virtual excursions. These opportunities to study topics in depth enable students to "become experts in charge of their own learning" (Partnership for 21st Century Skills, 2002, p. 12).

Teaching and learning processes in a 21st century context will create a situation in which students will need to understand the real world for appreciating the academic content (Dillon, 2006; Jonassen, et al., 1999; Ravitz, Becker, & Wong, 2000). This study of real world context will require both application and experience phases being achieved both inside and outside the school (Dillon, 2006; Kay & Honey, 2006; Trends, 2006). The 21st century age of teaching is for the purpose of devising techniques so that the

students can understand and retain most of the things that have been taught in school (Becker & Ravitz, 1999; Becker & Riel, 2000; Howard, McGee, Schwartz, & Purcell, 2000; Ravitz, Becker, & Wong, 2000). This approach is concerned with an inquiry-based method of teaching rather than traditional lecture; therefore education becomes relevant adding more to student's knowledge (Becker & Riel, 2000). The process will instill more relevant content ensuring total engagement of students with meaningful research in the study process. The new constructivist philosophy of education is not just innovation in the classroom but beyond that. The new viewpoint suggests the whole world is a school and that learning is a process which begins with birth and ends with death (Dillon, 2006).

"By teaching in a 21st century context, educators can create a balanced education that reflects both national concerns and local needs" (Partnership for 21st Century Skills, 2002, p. 12). The challenge for educators is to create a context for learning which is congruent with the content and the reinforcement of educational goals that will "enhance cognitive presence and the realization of higher-order learning outcomes" (Anderson, 2003, p. 4). By making content relevant to students' lives, bringing the world into the classroom, and taking students out into the world, opportunities arise for students to interact with others in authentic learning experiences. The authentic learning experiences help students make connections between the work they do in school and their world outside the classroom.

Technology, Education, and Integration

Students in the 21st century are different from those in the beginning of the 20th century. Technological devices that form a very integral part of our lives were not even imagined a hundred years ago. Prensky (2001) who coined the term digital native to refer

to today's students declares that "we can no longer use either our 20th century knowledge or our training as a guide to what is best for them educationally" (¶ 3). Now understanding the importance of this change of environment and student's psyche, schools all over the United States are under pressure to implement technology based education systems. With suggestions pouring in from all corners of the globe, from policymakers to the legislature; parents to educators; all have shown their interest in integrating technology in education (Brooks-Young, 2000). The business world has necessitated this technology integration into the classroom and therefore integration has become one of the most critical and challenging tasks for administrators and teachers (Hall, 2000). Now the government and other important agencies are beginning the implementation of 21st century skills with administrators being called upon for advice. The most important aspect of this collaboration with the business world is the support of the expertise of business executives concerning strategies that will contribute to the success of areas addressed in school reform including technology integration (Brooks-Young, 2000). These executives are basically the main decision makers and technically should be the first to support the assimilation of technology in schools if their ideas are being taken into consideration (Hall, 2000). "Technology use in the classroom must become as comfortable as it is outside the classroom. Teachers must practice putting engagement before content when teaching… pay attention to how their students learn and value and honor what their students know" (Prensky, 2001, ¶ 6).

Changing Roles of Teachers and Students

In their book *Windows on the Future: Education in the Age of Technology,* McCain and Jukes (2001) present the idea that just the knowledge gained through

experience is no longer adequate for instructing the students of today. They convey the message that teachers must never stop learning themselves; must rely on proven methods, but develop new instructional strategies, and must actively embrace new technologies if they hope to pass meaningful knowledge to their students.

Due to the influx of technology and information in a global society the roles of teachers and students are changing. Berge and Collins (1998) claimed that technology plays an essential role in the present and future of education. In their study, they found that students working with peers in a collaborative environment, with available and accessible technology tools, demonstrate enthusiasm, higher levels of thinking, and develop problem solving skills. Prior to the findings of Berge and Collins, Forman (1988) found that students enjoy learning in a technology rich environment that allows collaboration with other students and is facilitated by teachers.

Technology Integration

Although computers are now commonplace within our lives, integration within schools is much less ordinary (Ertmer, Gopalakrishnan, & Ross, 2001; Park & Ertmer, 2007-2008). The integration of technology begins with the use of computer technology in the classrooms (Office of Technology Assessment, 1995). Teachers who have successfully implemented computer technology in a lab setting have shown greater interest in modeling in the classroom based on the experience in computer labs. Their level of understanding in the use of technology plays a very instrumental role in furthering the usage of computer technology in the classroom (CEO Forum, 2001; Ertmer, et al., 2001; Mann, Shakeshaft, Becker, & Kottkamp, 1999).

Technology usage in schools has been undertaken for more than a decade for teaching programming (Roblyer, 2000). The same has also been used for addressing the need of computer literacy. Computer literacy has been successfully utilized through drill and practice for the implementation of integrated learning systems, and for active usage of Internet to ensure participation in various web-based social networking communities (Dias & Atkinson, 2001) like Second Life, MySpace, and Facebook. Since the advent of technologies available for teaching and learning, schools have been advocating considerable amounts of their funds for the procurement of hi-tech technologies. Despite this huge investment, little success has been achieved so far (Gulbahar, 2007).

In the United States, school districts reportedly spent $7.87 billion on technology equipment during the 2003-2004 school year (Quality Education Data, 2004). Hew and Brush (2007) discovered that despite the funding made available for technology, research studies in education show that although the use of technology can help student learning, its use is generally affected by certain barriers. Generally, the "barriers typically faced by K-12 schools...when integrating technology into the curriculum for instructional purposes include: (a) resources, (b) institution, (c) subject culture, (d) attitudes and beliefs, (e) knowledge and skills, and (f) assessment" (p. 232). Based on their research, Hew and Brush discussed strategies that need to be in place in order to overcome the potential barriers: (a) having a shared vision and technology integration plan, (b) overcoming the scarcity of resources, (c) changing attitudes and beliefs, (d) conducting professional development, and (e) reconsidering assessments.

Administrators and teachers must work together for the successful integration of computers and technology assisted instruction in the classroom. Findings from data

collected at a private school in Turkey indicated that even though teachers and administrative staff felt themselves competent in using ICT available at the school, they reported a lack of appropriate strategies that would lead them to successful integration (Gulbahar, 2007). Cuban (2001) in his book, *Oversold and Underused – Computers in the Classroom*, offers insight regarding the pressures and the traditions that both block and support teachers in making powerful use of these technology tools. Cuban points out that computers can be useful when teachers sufficiently understand the technology themselves, believe it will enhance learning, and have the power to shape their own curricula. Teachers getting competent support from administrators in tackling emotional and moral issues have been found to be more involved with the issue of technology integration in the classroom (Sandholtz, Ringstaff, & Dwyer, 1997). Hence the support from principals is extremely important in successful implementation of technology in the classrooms. The current proposal as mentioned in The Partnership involves technology integration in schools for communication, collaboration, and solution finding so that the content and objectives of the curriculum can be easily changed and refined.

Transformation in the current education practices is effective enough to infiltrate the educational process with technology integration. The chalkboard is a thing of the past; it has been replaced with an interactive whiteboard that projects animated images which can be manipulated with the touch of the hand and written on with a digital pen (Murphy & Lacy, 2007). The best educational practices would be the defining and then refining of various methods of teaching with technology promoting meaningful learning for students (Becker, 2000a). The newly refined methods include using a hand-held remote to respond to questions. Once the answers are recorded, the information is recorded in a computer

and instantly results are tabulated. This method allows the teacher to track the progress of the whole class.

The most important issue that has to be taken care of before integrating technology is the clear definition of the purpose of its implementation. Since the teachers are being supported by the technology leader in the integration process, the important issue is the computer literacy of the technology leader (in some cases this might be the principal). The technology leader must have enough computer literacy and basic technology skills and standards so that in case of any immediate support, the leader could provide some useful tips to the teachers (Bailey, 1997). A technology leader will be expected to be strong on some of the basic features that would assist in smooth implementation of technology.

The mandatory skills for the school's technology leader, as mentioned by Bailey (1997), are technology skills, people skills, curriculum skills, staff-development skills, and leadership. The capacity of principals in modeling of technology behavior is the deciding factor that conveys the direction to which the school is currently approaching. Being the leader, the principal must model professional as well as educational growth by participating with teachers in various professional learning activities, especially in the field of science and technology applications. By modeling professional and educational growth, teachers and supporting staff would eliminate their fear, apathy, or resistance when they are required to adopt technology and make learning more of a technology-integrated solution (Paben, 2002).

In order for the teacher to effectively integrate technology, according to Apple's (Apple Computer, Inc., 1995) research findings on technology's impact in the classroom, the following skills must exist:

1. Mastery of fundamental skills
2. Becoming a proficient user of technology
3. Preparing students with 21st century technology skills
4. Ability to motivate students to higher levels of achievement

Davenport (1998) evaluated the attitudes, beliefs, and preparation of teachers with regard to technology integration over a six-year span. The results of the study indicated that teachers view the computer much like they view the textbook, as the curriculum rather than as a tool to teach the curriculum. The 21st century skills vision should change the way teachers view the computer and other technology tools.

School Leaders and the Vision of 21st Century Skills

The work of the Partnership for 21st Century Skills envisions learning not just along the old philosophy of what the students are learning but also on how they are learning. The vision of 21st century learning skills is what an educator would wish to see. This is because of the expected increase in the number of students that will produce better results on classroom assessments; they will be able to demonstrate that they "know how to learn" (Partnership for 21st Century Skills, 2002). The incorporation of 21st century tools into regular administrative schedules and classrooms will help educators concentrate on the teaching and learning process and then infuse another wave of technological explosion with reference to real world context (Partnership for 21st Century Skills, 2002). Education will probably never be able to surpass each new wave of

technology, but if educators are able to stay abreast of technology as it emerges, it will be an improvement (Becker & Ravitz, 1999).

A New Look at 21st Century Learning

Learning in the classroom will generate a new relationship between the teacher and the student thereby engaging and modernizing various methods for assessment as well as study (White, 2007). "Student tasks that are taught from a constructivist approach often resemble work in the real world; that is, they are 'authentic" activities' (Jones, as cited by Becker & Ravitz, 1999, p. 387). The broader relationship between educators and students will give real time information to the teachers about the performance of the students. As teachers facilitate student learning, they can search for newer methods to help their students (Becker and Ravitz, 1999). The process of teachers' facilitating learning and using formative assessment as "assessment for learning" will ensure more compact relationships and the students will learn in a very short period rather than in several months (Stiggins, 2002). The urgency itself provides an opportune time for states and school districts to start the integration of 21st century skills into the education system. West Virginia and its local school districts have seriously responded to No Child Left Behind and is a state that realizes the importance of improvement in the quality of education (Trends, 2006). West Virginia schools are now facing a task to maintain the relevancy of what they teach. Strategic long term planning is in place so that 21st century skills have been integrated into the Content Standards and Objectives (Henke, 2007). The concept of assessment of the curriculum and the different elements of 21st century skills will enhance the effectiveness of this concept. The education leaders can conceptualize

several local ideas with input from students, teachers, and local residents to effectively implement 21st century skills in community schools.

Constructivist Learning Theory

Constructivism is a learning theory that proposes learners will create their own understanding as they combine what they already believe to be true based on their past experiences with new experiences (Richardson, 1997). Constructivism as a philosophy of learning can be traced primarily to the work of John Dewey (1916) and Jean Piaget (1973). Vygotsky's (1978) work also contributed to the movement toward constructivism. Until most of the early to middle part of the 20th century, theories of learning shifted from an orientation based on observable phenomenon to an orientation in the 1970s that emphasized internal cognitive processing. By the 1980s, a shift toward constructivism became evident (Gilbert, 2001).

The belief that learning is intrinsic in nature continues to grow. Knowledge is constructed in a personal way, where understanding and meaning is developed and understood by the learner. The learning context must be a social context in which students work together to build knowledge. Children should be encouraged to develop concepts and derive their own ideas from those introduced to them. A social learning perspective should be developed through which children learn through interaction with others (Gilbert, 2001).

Critical thinking is one of the areas where over the decades both educators and policymakers have argued (Becker & Ravitz, 1999; Brown, Collins, & Duguid, 1989; Jonassen, et al., 1999; Venetucci, 2001). Much of this debate has not been based on empirical data. Wenglinsky (2004), using data from the National Assessment of

Educational Progress (NAEP), concluded that a clear pattern emerges from the analysis of these data. Even though students must learn facts and basic skills, the data suggest that emphasizing advanced reasoning skills promotes higher student performance. The use of constructivist pedagogical models promotes this meaningful type of learning process, a process in which learning helps students make sense of new information experienced in authentic problems by integrating the new information with previously constructed knowledge (von Glasersfeld, 1981).

In an increasingly global world, it is not enough for students to acquire content knowledge alone. Skills like creativity, problem solving, communication, and analytical thinking are necessary for all levels of success, from entry-level jobs to engineering and technical fields (Partnership for 21st Century Skills, 2006). By offering students numerous choices for personalizing and individualizing instruction to meet their needs, they will be able to show their strengths. "Directing one's own learning path is not only valuable, but necessary, in the 21st century" (p. 6). A constructivist approach to learning provides students access to collaborative, self-paced learning environments that can facilitate 21st century skill development (Partnership for 21st Century Skills, 2006).

Problem-Based Learning

Authentic problems or actions are ill-structured complex problems analogous to those from which students learn in everyday experience and will comfortably face in their future professions. Hence the course of action that is being required should be more authentic (Brown, Collins, & Duguid, 1989). Problems encountered in the learning process increase the reasoning and problem solving approach. This day-to-day activity if incurred naturally will help the individual to the larger extent prepare for a successful

future (Voss, 2005; Voss & Post, 1998; White & Frederiksen, 1998). The philosophy of constructivism is not new to education, but the ways in which it is applied to education are still evolving. Both teachers and students are actually learning (Bereiter & Scardamalia, 1987). One relatively new approach that can play a vital role in the use of constructivist teaching practices is technology-enhanced instruction.

According to Moylan (2007) there is a general consensus among educators, business, and other interested parties that a significant gap exists between the knowledge and skills needed for success in life and the current state of education in primary and secondary education schools throughout the world. Problem-based learning has been identified as a key methodology for closing this gap between current student learning and developing the necessary knowledge and skills critical for success in the 21st century. "The seven key skill sets identified as essential are: 1) critical thinking and problem-solving; 2) creativity and innovation; 3) collaboration, teamwork and leadership; 4) cross-cultural understanding; 5) communications and information fluency; 6) computing and ICT fluency; and 7) career and learning self-reliance" (Moylan, 2007, p. 1). These seven skills are gained by students when engaged in problem-based learning activities.

Learning and innovation skills are being recognized as the skills that separate students who are prepared for increasingly complex life and work environments in the 21st century, and those who are not. A focus on creativity, critical thinking, communication, and collaboration is essential to prepare students for the future (Partnership for 21st Century Skills, 2006). Problem-based activities are designed to place students in a students-as-workers setting where they learn collaboration, critical thinking, written and oral communication, and the values of the work ethic. "Today's graduates

need to be critical thinkers, problem solvers, and effective communicators, who are proficient in both core subjects and new 21st century content and skills" (p. 4).

Technology and Constructivism

The newer technology generally in the form of computers and Internet has provided a different approach to authentic educational activities. One of the first and most vocal proponents of the use of technology to promote this type of meaningful learning was Seymour Papert (1980; 1994) who believed that computers could provide a powerful tool for learning. He also noted that schools have frequently ignored the broad capacities of computers for instructional support, isolating them from the learning process, rather than integrating them into all areas of the curriculum. Using the techniques of constructivism effectively, teachers can teach or educate their students in a better way. Teachers are beginning to use technology as a tool to promote students' ability to reason and solve authentic problems. Teachers have now been using technology and also integrating the use of technology into formal education systems with the intention to "transform classrooms into technology intensive knowledge centers providing purposeful learning with experimental learning that would intuitively create an environment of authentic action rather than awareness and simple information" (Moersch, 1996, p. 53). The effective use of technology can lead to higher cognitive skill development and thinking skills such as problem solving, reasoning, decision-making, and scientific inquiry (Moersch, 1999).

In 2003, Woodbridge found that integrating technology effectively was demonstrated across grade levels and course content in 50% of the classrooms he observed. He identified teachers using such constructivist teaching strategies as active,

authentic, constructive, cooperative, and intentional/reflective learning. Results of his study revealed that "technology integration varied according to individual teaching beliefs, perceptions towards technology innovations, and how the teacher practiced and put technology to work in the classroom" (p. 246). Increasing reliability in the classroom can be achieved through the use of positive teaching methods (Voss & Post, 1998; Wenglinsky, 2004; White & Frederiksen, 1998).

Teaching, Learning, and Computing Survey

In their study, Ravitz, Becker, and Wong (2000) analyzed the findings of a 1998 national survey of teachers. The Teaching, Learning, and Computing (TLC) survey was given to 4,083 teachers who taught all subjects except physical education and special education in classrooms from the 4th through 12th grades. The survey was designed to investigate how teaching philosophy and beliefs affected teaching strategies regarding computers. Teachers surveyed were presented with teaching scenarios that described traditional teaching strategies with directed instruction or constructivist teaching approaches. Ravitz, et al. wanted to find out if teachers who actively used technology in the classroom tended to favor one teaching strategy as a result of the philosophy about teaching. They concluded, "Constructivist-oriented teachers use computers professionally in more varied ways, have greater technical expertise in the use of computers, use computers frequently with students, and use them in apparently more powerful ways" (p. 6). Becker (2000c) later repeated the earlier findings:

> Overall, it is clear that teachers with the most constructivist teaching philosophies are stronger users of computers: They use computers more

frequently, they use them in more challenging ways, they use them more themselves, and they have greater technical expertise. (p. 20)

When teachers are thorough and have totally integrated technology into their classrooms then the existence of a very different environment comes into being. A constructivist learning environment (Reeves, 1998) is a place in which learners work together and support each other as they use a variety of tools and information resources in their guided pursuit of learning goals and problem-solving activities. Constructivist learning environments frequently encompass many different applications of media and technology, in particular the use of computers for productivity applications like word processing, database, and spreadsheet applications; general reference materials on CD-ROM; drawing or painting software; desktop publishing and presentation tools; Internet software; authoring software; image-editing and multimedia development software; programming languages, Web development tools; and CAD/CAM programs (Becker & Ravitz, 1999; Middleton & Murray, 1999; Rakes, Flowers, Casey, & Santana, 1999). Classrooms under this environment are active with the combination of the tools of constructivism with communication and visualization tools that enable communication and collaboration among learners in a socio-cultural context. Increased student achievement can result because of the synergy created through dynamic interactions (Dwyer, 1994; Sandholtz, Ringstaff, & Dwyer, 1997).

Apple Classroom of Tomorrow Study

To understand the effect of using routine technology by the teacher for teaching students the Apple Classroom of Tomorrow (ACOT) project studied five classrooms throughout the United States (Dwyer, 1994; Sandholtz, Ringstaff, & Dwyer, 1997). The

study made an analysis of the use of technology for ten straight years and the researchers had provided each classroom with a vast variety of technology tools, training for teachers, and a coordinator at each school to provide technology assistance. The project's basic objective was to investigate how the processes of learning and teaching can be influenced by routine use of computers and technology.

The ACOT project provided a large set of data to make up a database of almost 20,000 entries for the purpose of analysis. The analysis provided a view of the teachers' collective thoughts "documenting general trends related to classroom management" (Sandholtz, et al., 1997, p. 3). Concerns during the evolution of the project found researchers concluding that this technology project actually disturbed the stability factor for which classes are generally known for, classroom management. The teachers "began to employ student experts as peer teachers, and generally their teaching approach shifted from instruction-centered to learner-centered. This shift resulted in greater student interest and motivation, causing students to be more confident and competent learners" (Dwyer, 1994, p. 7). Researchers saw an increase in the use of constructivist teaching strategies with the use of technology in the classroom. This observation was supported by various other researchers including Rakes, et al. (1999) and Becker and Ravitz (1999). Teachers encouraged cooperative learning and collaborative efforts as they used more complex tasks and materials in their instruction along with more performance-based evaluations (Becker, 2001; Becker & Ravitz, 2001; Brown, Collins, & Duguid, 1989).

Emerging Technology in Education

However, even with the increased use of technology, there is a strong need for the use of more up-to-date technology on a day-to-day basis. For example, students should be

using Web 2.0 tools to engage in regular collaboration, access and "remix" digital information, and extend their learning beyond the traditional school day. "Students who have access to technology outside of school will find schools without access to and integration of technology into their coursework to be antiquated and irrelevant to their world" (Partnership for 21st Century Skills, 2002, p. 7)

Teachers need to be trained by concerned authorities that provide authentic, interactive experiences that support learning so they can create an environment which will ultimately be beneficial to their students. The research clearly shows that students learn more when they are engaged in meaningful, relevant, and intellectually stimulating work (Newmann, Bryk, & Nagaoka, 2001). While all learning is deeply personal, the frequency and relevance of such moments increase when technology enables teachers and students to tap outside experts; visualize and analyze data; link to real-world contexts; and take advantage of opportunities for feedback, reflection, and analysis (Bransford, Brown, & Cocking, 1999). For example, blogs and wikis provide online opportunities for networking and collaboration and podcasting enables students to tap outside experts. There is a need for further research on the link between teachers' technology usage and classroom instructional practices (Becker & Ravitz, 1999). In spite of the apparent commitment to technology in some schools, it appears that many teachers only use computers to support their current traditional teaching practices rather than as a tool to promote more innovative, constructivist practices (Cuban, 2001). Much of the current teacher technology training programs and other uses of technology-related funds may not be delivering the desired result: a positive effect on student learning (CEO Forum, 2001).

In short, teachers must acquire the desired skill level which helps them in gaining knowledge in the use of computer-based technology. Survey data (Fuller, 2000) collected from the leading technology support person and the 5th and 11th grade students in their schools revealed that most students have said that their teachers do not use computers in sophisticated ways. Fuller explained that if the teachers are not provided the support needed to integrate computers into the overall framework of the classroom, it is unlikely that their students will use computers in ways that will improve their learning process. Fuller suggested that in order to have a positive impact on teaching methods, technology has to be made a familiar entity not just for teachers but also for students; teachers must possess the technology-related skills needed to use technology and must actively use these tools in their classrooms. In order to encourage these behaviors, teachers need appropriate, research-based training; opportunities to practice these skills; access to technology tools; and support, both in terms of encouragement from school administrators (Dawson & Rakes, 2003) and technical support (Fuller, 2000). Best (2002) concluded that teacher reflections on their experience, teacher professional knowledge, teacher's educational beliefs, and school-wide implementation are catalysts for change.

The Need for Change

The world in this 21st century is a much better place to live than ever before (Partnership for 21st Century Skills, 2006). Human interactions with nature's surroundings have made it possible for man to understand the very nature of the world he lives in and how the same can be harnessed for the use of humans. This very nature of man actually led to the beginning of a new method in the way things around us should be approached (Hartwell, 1996).

> For many students the impact of technology on everyday life is no surprise. They connect with their friends via e-mail, instant messaging, and chat rooms online; search the Web to explore their interests; express themselves fluently using new media; learn with educational software; play video and computer games in virtual realities; manipulate digital photos; go behind the scenes on DVDs; channel surf on television; and chat on and take photographs with cell phones. Through the media, they identify with their peers in the global culture through music, games, toys, fashion, animation, and movies. (Partnership for 21st Century Skills, 2004, p. 7)

The students of today are not being prepared for learning in this digital, complex society (Partnership for 21st Century Skills, 2004). Educators must change the way they prepare students for the future.

The Scientific Approach to Change

The scientific approach has been instilled into each one of us and technology now provides a way to develop that scientific approach. Hartwell (1996) indicated that scientific experts and experts of other domains possess advanced forms of the scientific or artistic approach to learning and have been the most important factor in bringing technology powered revolutions in a majority of the instances for application of knowledge to work. So, in short, it can be stated that technology has demystified the various intricacies of the world.

Less than a century ago, education's function was to pass on the knowledge, skills, and wisdom of the past to the next generation.

> To prepare today's child to cope in the 'learning society' of the 21st century, it is clearly essential to focus on learning how to learn, how to solve problems, how to synthesize the new with the old. There is a strong likelihood that this view of the role of education, which is now more rhetorical than practiced, will become a matter of social survival. (Hartwell, 1996, No. 11, ¶ 2)

All of mankind is benefited by understanding the different aspects of this earth, nature, space and many other things which directly or indirectly affect the existence of man (Hartwell, 1996). Just by understanding things we can make ourselves ready for development and disaster; we can overcome our limitations and fight the natural adversities so that our thirst of exploration could get a boost. We simply cannot give any answer to these questions just by understanding education. Education requires application to magnify its utility and for that we need technology. This sector which is also referred to as the sector of applied science and information technology boasts of a completely different type of technique to sort out problems (Partnership for 21st Century Skills, 2006).

The management of science and technology enhance the worth of any theory or postulates or form of education (Wenglinsky, 1998). The difference between current education and education through the use of technology can be simply understood. Wenglinsky declares that when educators discover and use technology better outcomes are the result. The world will be different. The new work force under the guidance of technology will provide things that are totally unseen and unspoken. The 21st century

skilled students are futurists who explore the whole world to get the best possible answer (Partnership for 21st Century Skills, 2006).

Ways to Make Education Relevant in Today's World

The implementation of 21st century skills is actually the only way to make education relevant with few complications. It is the technology leaders who will have to shoulder the responsibility of implementing solutions. It is these solutions which are supposed to smooth the journey of a student into the world of educational technology. Technology leaders use their skills and knowledge that are backed by logical thinking and understanding of different needs of both teachers and students to search for solutions to problems that may arise while implementation takes place (Blasé & Blasé, 2000).

The implementation of 21st century skills and tools as a whole affects everything that surrounds our education today. A national poll conducted by Peter Hart Research Associates for the Partnership for 21st Century Skills (2007) revealed that "Americans know that a 21st century education must incorporate a different set of skills that reflect changing economic demands" (¶ 11). The outcome of efforts made by The Partnership has the potential to make everything present around us simpler, easier and better to use or operate, provided we make education relevant to the world around us. The findings mentioned above are a very short depiction of the process of educational change, but technically The Partnership is the first of its kind in the history of U.S. schools (Partnership for 21st Century Skills, 2006).

From being one of the most sought after systems of the 20th century, the education system of today has been at the stage of irrelevancy and might fail one day from being the actual growth engine of the United States of America. Modern age

students are expected to be equipped with 21st century skills so that they can effectively research, conceptualize, organize and present ideas, and debate current affairs, skills that will make them a link between the top management and the work force at the entry level (Partnership for 21st Century Skills, 2006).

Education Solutions

The possible solution to problems of today's education requires the application of different processes involving research based strategies. The 21st century skills have been designed to develop a new sort of citizen who is not only sound in education but also in social values and morality. In *Road to 21st Century Learning: A Policy Guide to Twenty-First Century Skills,* The Partnership (2005) describes a successful model for learning that incorporates 21st century skills into our present education system:

> To thrive in the world today, students need higher end skills, such as ability to communicate effectively beyond their peer groups, analyze complex information from multiple sources, write or present well-reasoned arguments about nuanced issues and develop solutions to interdisciplinary problems that have no one right answer. (p. 4)

The application of the processes necessary to communicate effectively will ensure different types of support to students. The child in its formative age sees many things and in accordance with his understanding capability he makes decisions (Oblinger & Oblinger, 2005). According to research conducted by the Partnership for 21st Century Skills (2004) "many of the most tech-savvy teens complain that the resources and teaching aids available on the Web are not well understood or well used in most classrooms" (p. 5). Further, they found that "the majority of educational Web use by

teen-aged students occurs outside of the classroom" (p. 5). If students are to see changes in the classroom that reflect the connection between school and the world they live in, then teachers must begin to integrate technology and make assignments more engaging (Partnership for 21st Century Skills, 2005).

Summary

The review of the literature supports several conclusions. It reveals the reasons for determining how often West Virginia PK-12 teachers are using 21st century technology tools to create a 21st century context for learning and the need to discover the factors that influence West Virginia PK-12 teachers' use of 21st century technology tools to create a 21st century context for learning. Through the literature review, the researcher discovered the role of technology in society today, the development of technology standards, critical elements for implementing 21st century skills, technology integration, vision of school technology leaders, constructivist teaching practices, and the need for changes in education. All of these essential ingredients for effective use of technology are factors that contribute to the relationship West Virginia has developed with the Partnership for 21st Century Skills. West Virginia supports the belief of The Partnership that education must meet the needs of its 21st century learners.

Several initiatives build the foundation for optimal conditions in schools for technology use. Planning and vision are critical to technology integration and implementation. An organized plan with well-defined goals and objectives and proper leadership are key. In addition, a concrete and shared plan sets the stage for developing a vision and goals to be attained and for educators to feel comfortable taking the necessary risks involved. Conditions such as adequate technical support and networked hardware

connected to the Internet also play a significant role. Resources such as hardware, software, and access coupled with properly placed personnel promote the optimal conditions influencing technology use. Policies such as West Virginia's Technology Content Standards and Objectives incorporate an expected level of technology competency and use in every grade level and subject from PK-12 to lead the efforts for technology integration. Other national initiatives such as the ISTE and NCLB also call for technology literacy of our students.

Educators will be valuable contributors to the use of technology. The use of technology in the classroom is varied. Likewise the reasons for technology use, or lack of use, are just as varied. The ultimate goal is to have technology fully integrated into the curriculum so that it is a seamless task for students and teachers alike. When this occurs, our students and teachers are well on their way to effectively using technology demonstrating they are preparing students for living in the 21st century. As the literature suggests, technology is a tool that must be harnessed to well-defined and measurable learning outcomes. Technology can facilitate learning while also preparing students and teachers for improved performance. The need of the hour is to make these approaches a common feature or better to say a norm in all West Virginia schools. The vision for education presented in various sections of this document will help policymakers and educators align student achievement with 21st century expectations – by building on the good work they already have started across the state.

CHAPTER THREE: METHODS

This chapter describes the research methods used in this mixed methods study. Creswell and Plano-Clark (2007) declare, "It is not enough to simply collect and analyze quantitative and qualitative data; they need to be "mixed" in some way so that together they form a more complete picture of the problem than they do when standing alone" (p. 7). Mixed methods research is considered a new approach, having emerged in the last decade (Creswell & Plano Clark, 2007). The description of the study's research design, population and sample, instrumentation, data collection procedures, and data analyses are outlined in this chapter.

The mixed methods approach allowed the researcher to use quantitative and qualitative methods to gather data on West Virginia PK-12 teachers' readiness to implement the Partnership for 21st Century Skills initiative via an instrument entitled *West Virginia Teachers' Technology Tools and Use Survey* (Appendix A). The instrument utilized closed-ended and open response questions that provided respondents the opportunity to reveal whether or not West Virginia PK-12 teachers are using 21st century technology tools to create a 21st century context for learning.

Research Questions

The following research questions are addressed:

1. How often are West Virginia PK-12 teachers integrating 21st century technology tools as defined by the Partnership for 21st Century Skills?
2. How often are West Virginia PK-12 teachers integrating 21st century technology tools to create a 21st century context for learning as defined by the Partnership for 21st Century Skills?

3. What factors influence West Virginia PK-12 teachers' use of 21st century technology tools to create a 21st century context for learning?

Research Design

This mixed methods study utilized a "parallel" design approach (Creswell, 2003) involving data collection using both quantitative and qualitative methods simultaneously. A questionnaire was administered which contained both closed-ended and open response items and focused on West Virginia teachers' implementation of The Partnership, concentrating on using 21st century technology tools and creating a 21st century context for learning.

> 'Mixed methods have particular value when a researcher is trying to solve a problem that is present in a complex educational or social context…Mixed methods have the potential to contribute to addressing multiple purposes and thus to meeting the needs of multiple audiences for the results.' (Teddlie & Tashakkori, as cited by Mertens & McLaughlin, 2004, p. 113)

The blending of closed-ended and open response items provided a rich and comprehensive picture of the study (Creswell, 2003). The mixed approach applied by this study filled the gaps that existed between the quantitative and qualitative data components.

Quantitative data collection was used to examine how often West Virginia PK-12 teachers integrate 21st century technology tools as defined by the Partnership for 21st Century Skills. Both quantitative and qualitative data collection was used to determine how often West Virginia PK-12 teachers integrate 21st century technology tools to create

a 21st century context for learning as defined by the Partnership for 21st Century Skills and to discover the factors that influence West Virginia PK-12 teachers' use of 21st century technology tools to create a 21st century context for learning.

Population and Sample

The population for this study was all PK-12 West Virginia teachers. The total population of West Virginia PK-12 teachers employed full time during the 2007-2008 school year was 19,713, according to reports from the West Virginia Department of Education. Wimmer's (2001) *Sample Size Calculator,* a source referenced by Survey Monkey, was used to determine an appropriate sample size. Zoomerang's (2008) recommendation to obtain results that reflect the target population as precisely as needed, verified the appropriate sample size for the population. To maintain a confidence level of 95% and a 5% confidence interval, an appropriate sampling size for a population of 20,000 is 377 (Wimmer, 2001; Zoomerang, 2008). To account for an expected return rate of 50% plus one, 752 requests to complete the web-based survey were sent to the randomly selected sample of West Virginia PK-12 teachers. The actual return of 446 (59.3%) surveys yielded a 95% confidence level with a 4.56% margin of error.

The population was obtained from the West Virginia Department of Education database. A random sample of 752 PK-12 teachers was selected using the Statistical Package for the Social Sciences (SPSS). The process of random selection provides each participant an equal chance of selection independent of any other variables in the selection process (Babbie, 1990). The process of random sampling allowed for controlling sampling error (Smith & Glass, 1987). The decision to use random sampling was made in order to eliminate the danger of researcher bias and allow for the possibility

of alternative explanations to be discounted, thus increasing the internal validity of the study.

Instrumentation

In order to answer the research questions, the *West Virginia Teachers' Technology Tools and Use Survey* (Appendix A) was developed by the researcher. The extensive review of literature included in the second chapter was used to identify appropriate items for inclusion within each section of the survey.

The first part of the survey included closed-ended items designed to answer research question one. Respondents indicated how often they integrate 21st century technology tools using a 7-point Likert scale. "The particular value of this format is the unambiguous ordinality of the response categories" (Babbie, 1990, p. 164). The level of use had responses on a scale from 1 to 7 with 1 = "Not at All," 2 = "Less Than Once a Month," 3 = "Once a Month," 4 = "Several Times a Month," 5 = "Once a Week," 6 = "Several Times a Week," and 7 = "Daily."

The second part of the survey consisted of closed-ended items designed to answer research question two. Respondents indicated how often they integrate 21st century technology tools to create a 21st century context for learning. Teachers were asked to use a 7-point Likert scale to rate the frequency of use of 21st century tools to create a 21st century context for learning for each statement. The level of use had responses on a scale from 1 to 7 with 1 = "Not at All," 2 = "Less Than Once a Month," 3 = "Once a Month," 4 = "Several Times a Month," 5 = "Once a Week," 6 = "Several Times a Week," and 7 = "Daily." This section also included an open response item designed to gather additional evidence of teaching in a 21st century context.

The third part of the survey consisted of yes - no items designed to answer research question three. Respondents were asked to identify the factors that influence their use of 21st century technology tools to create a 21st century context for learning. An open response item, designed to provide respondents the opportunity to indicate support mechanisms and barriers that occur while using 21st century technology tools to create a 21st century context for learning, was also included.

Finally, respondents were asked to provide demographic data including: age range, grade level(s) currently teaching, school's socioeconomic status, participation in 21st century technology use/integration professional development, online course/workshop completion, and participation in WVDE sponsored 21st century initiatives. The primary method of gathering data was a web-based survey. The ability to collect large amounts of data and to process answers without separate data entry makes the expense of doing web-based surveys very attractive (Witt & Poynter, 1998).

According to Rogers (1995) "content validity is the extent to which items in an instrument reflect the universe to which the instrument will be generalized" (as cited by Boudreau, Geffen, & Straub, 2001, p. 6). "This validity is generally established through literature review and expert judges or panels" (p. 6). Since the researcher developed the instrument, a panel of experts (Appendix B) was asked to perform a critical review (Appendix C) of the survey (Appendix A) (Charles & Mertler, 2002; Fowler, 2002) before its application in the primary research setting. The panel of experts was composed of educators who are actively using technology in either their research or their teaching assignments. Bailey (2007) suggested use of a panel of experts as an important research technique for enhancing validity. Responses from the panel of experts were used to revise

the survey before its use in the primary research setting. Dillman (2007) provided a series of questions that were asked about each item included in the study to assure content validity. Each member of the panel was asked to use the questions provided in Appendix C. Boudreau, Geffen, and Straub (2001) agreed with other researchers that every instrument should be either pretested or evaluated by a panel of experts "no matter how skilled the researcher" (p. 8).

Survey respondents were ensured confidentiality. No attempt was made to capture information that was not provided voluntarily by respondents. Coomber (1997) suggests that respondents can either use an anonymous terminal (for example, a computer in a public library or cyber-cafe) where the electronic responses cannot be traced to an individual, or print the questionnaire and send it to the researcher via regular mail. As suggested by Fowler (2002) a simple identifying PIN number was included in the e-mail notification request (Appendix D) to complete the questionnaire for the purpose of re-contacting non-respondents. The identifying PIN number was also explained in the initial notification mailing (Appendix D). Since it is nearly impossible to fully guarantee the respondent's anonymity, participants were guaranteed confidentiality.

Data Collection Procedures

Dillman (2007) explains the design method for achieving high response rates from a Web survey. This method includes respondent-friendly questionnaires, using only a portion of the capacity of the most advanced computers in order to reach an audience with a variety of browsers and computer configurations to advance the likelihood that recipients of questionnaires are likely to respond, multiple contacts with the respondent by multiple modes, mixed-mode surveys so that people without computer access can

respond by other means, incentives, and other response inducing techniques to improve the likelihood of a response (Dillman).

The design of the *West Virginia Teachers' Technology Tools and Use Survey* (Appendix A) was based on Dillman's (2007) E-mail and Web Design Principles which include utilizing a multiple contact strategy, personalizing all e-mail contacts, keeping the cover letter brief, informing respondents of alternative ways to respond, including a replacement questionnaire with the reminder message, introducing the web questionnaire with a motivating welcome screen, providing a PIN number for limiting access only to people in the sample, presenting each question in a conventional format, refraining from the use of color, avoiding differences in visual appearance of questions, and providing specific instructions on how to take necessary computer action for responding to the questionnaire. The data collection procedures for this study included all of the suggested *Tailored Design* (Dillman, 2007) except offering incentives. Dillman's (2007) new paradigm responds to recent developments that affect the success of surveys. Dillman's data collection procedures were expected to increase response rates and obtain high-quality feedback web-based surveys. Respondents were offered the opportunity to request a copy of the results of the research study.

The primary method of collecting data was electronic. Since multiple contacts are important for maximizing response to e-mailed surveys, five contacts (three by e-mail and two additional special contacts) were made. The first contact was a notification message (Appendix D) sent by postal mail to the target population to reinforce the simultaneous delivery of an e-mail message requesting participation in the study. Both the special contact mail notification and initial e-mail messages contained the Web

survey address and a personal PIN number that the respondent was requested to submit when completing the survey. "The main purpose of the pre-notice is to leave a positive impression of importance so that the recipient will not immediately discard the questionnaire when it arrives" (Dillman, 2007, p. 368).

The initial notification e-mail letter (Appendix D) followed Dillman's (2007) design. The first two paragraphs explained the reason for conducting the survey, how the respondent was selected, and the importance of the study. The third paragraph assured confidentiality and explained approval by the Marshall University Institutional Review Board from the Office of Research Integrity. The third paragraph also explained the identifying PIN number to be entered with the survey as a method to send follow-up surveys to non-responders. The fourth paragraph offered respondents the opportunity to receive additional information about the study. The fifth paragraph re-emphasized the basic justification for the research study. Respondents who wanted additional information were asked to send an e-mail requesting additional information. Having respondents put their address in the e-mail response and not in the survey helped reinforce the promise of confidentiality.

Based on institutional review board approval (Appendix D), e-mail reminders (Appendix E and F) were sent to non-responders. The first reminder (Appendix E) was sent after one week in the form of a follow-up reminder e-mail to convey a sense of importance (Dillman, 2007). The reminder contained a link to the *West Virginia Teachers' Technology Tools and Use Survey* (Appendix A) and the respondent's PIN number in case it had been misplaced. The second and third follow-up email reminders (Appendix F), also containing the respondent's PIN number, were sent two days prior to

and on the day of the deadline for submission of the survey. A fifth contact in the form of a mailed survey packet (Appendix G) was sent to each remaining non-respondent. Respondents were asked to complete the survey within two weeks of receipt. Returned surveys were tracked daily with a return rate graph (Appendix H).

Data Analysis Procedures

Quantitative data related to each research question was analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, including frequencies, mode, mean, and standard deviation were used to answer each research question. Ancillary findings based on demographic information were also reported where significant as identified by the Kruskal-Wallis one-way analysis-of-variance-by-ranks.

Qualitative data were analyzed and interpreted based on the open response items included for research questions two and three. Bogdan & Biklen (2003) emphasize the point that analysis is an ongoing process that occurs while the researcher establishes patterns and develops findings while interpreting the data. By deploying a cross-case analysis, the researcher was able to look for similar themes and patterns in the data and analyze discrepancies in notable outcomes or attributes and their contributing factors (Creswell, 2003). Additionally, the researcher was able to "identify emergent categories from the qualitative data and then use the quantitative phase to examine the prevalence of these categories within different samples" (Morse, as cited by Creswell, 2003, p. 78).

The decision to use both quantitative and qualitative data collection methods was based on the appropriateness of examining different facets of The Partnership, for triangulation, and for adding depth and breadth to the issues and factors that influence West Virginia PK-12 teachers' use of 21st century technology tools and creating a 21st

century context for learning being studied. These purposes are consistent with the suggestions made by Greene, Caracelli, & Graham (1989) about the use of both quantitative and qualitative methods of research in a singular study.

Summary

This chapter provided information related to the procedures used to collect and analyze data. This mixed-methods study was designed to examine the readiness of West Virginia teachers to implement the Partnership for 21st Century Skills initiative. Information for this study was collected through a self-report questionnaire entitled *West Virginia Teachers' Technology Tools and Use Survey* (Appendix A). Findings of the study are presented in Chapter 4.

CHAPTER FOUR: PRESENTATION AND ANALYSIS OF DATA

Introduction

This mixed methods study utilized a "parallel" design approach involving data collection using both quantitative and qualitative methods simultaneously. The study was designed to examine how often West Virginia PK-12 teachers are integrating 21st century technology tools as defined by the Partnership for 21st Century Skills, how often West Virginia PK-12 teachers are integrating 21st century technology tools to create a 21st century context for learning as defined by the Partnership for 21st Century Skills, and to discover the factors that influence West Virginia PK-12 teachers' use of 21st century technology tools to create a 21st century context for learning.

Research was both quantitative and qualitative in nature, using a researcher-designed instrument. Based on an in-depth review of the literature, the instrument, *West Virginia Teachers' Technology Tools and Use Survey*, contained seven sections. Section one was designed to gather quantitative data that examined how often teachers integrate 21st century technology tools as defined by the Partnership for 21st Century Skills. Section two was designed to gather quantitative data regarding how often teachers use 21st century technology tools to create a 21st century context for learning. Section three was designed to gather qualitative data regarding technology related assignments that teachers frequently ask their students to complete. Section four was designed to determine the factors that support teachers' use of 21st century technology tools. Section five was designed to determine the factors that create barriers to teachers' use of 21st century technology tools. Section six was designed to gather qualitative data describing both barriers and support mechanisms that influence teachers' use of 21st century

technology tools. Section seven included demographic questions. Respondents were asked to complete the survey online and those participants who did not complete the online survey within two weeks were sent a survey to return by mail. Participation in the survey was completely voluntary. Findings related to the research questions, demographic information, and ancillary findings are presented in this chapter.

Population and Sample

The population for this study consisted of 19,713 West Virginia PK-12 teachers. A random sample of 752 teachers was selected from the database of full time PK-12 teachers provided by the West Virginia Department of Education. The sample size of 377 out of a population of 19,713 was needed for generalizability to the population. The actual return of 446 (59.3%) surveys resulted in a 95% confidence level with a 4.56% margin of error or a 99% confidence level with a 6% margin error. This return was a result of planned multiple emails and mailings.

Of the 752 teachers selected to participate in the study, 94 returned the *West Virginia Teachers' Technology Tools and Use Survey* on the first emailing and simultaneous postal mailing, representing 12.5% of the sample population. Email reminders were sent one week later to the non-respondents who had not opted out, and 84 more surveys were returned. Two days before the online survey deadline, a second email reminder was sent to the remaining non-respondents who had not opted out, and 56 more surveys were returned. Because the majority of school districts were observing Spring Break when the initial mailing was sent, a third email reminder was delivered on the day the online survey was to be completed and 41 more surveys were returned. A complete mailing of the survey packet to 464 non-respondents who had not opted out resulted in

147 additional surveys returned by mail and 24 more completed online for a total of 446, representing a 59.3% total response rate. A return rate graph is included in Appendix H. Although the emails and mailings resulted in 446 returned surveys, the number of responses for each statement on the survey varied due to the nature of a self-report survey. In addition to the 446 respondents, 21 opted out by requesting that they not be contacted in the future, 10 submitted blank surveys, 18 emailed notification that the link they received did not work or requested to have the survey sent to their personal email account, three emailed notes stating that they were no longer in the classroom, and three emailed a request to receive survey results.

Major Findings

This section presents major findings organized to correspond with each research question.

1. How often are West Virginia PK-12 teachers integrating 21st century technology tools as defined by the Partnership for 21st Century Skills?
2. How often are West Virginia PK-12 teachers integrating 21st century technology tools to create a 21st century context for learning, as defined by the Partnership for 21st Century Skills?
3. What factors influence West Virginia PK-12 teachers' use of 21st century technology tools to create a 21st century context for learning?

All research questions were answered by utilizing the survey instrument, *West Virginia Teachers' Technology Tools and Use Survey*. A quantitative component of the survey provided how often West Virginia PK-12 teachers integrate 21st century technology tools. The survey included both quantitative and qualitative components to determine how often

West Virginia PK-12 teachers integrate 21st century technology tools to create a 21st century context for learning and to identify factors that influence West Virginia PK-12 teachers' use of 21st century technology tools to create a 21st century context for learning.

Research Question One: 21st Century Technology Tools

The first section (question 1) included 31 items that dealt with how often West Virginia PK-12 teachers integrate 21st century technology tools as defined by the Partnership for 21st Century Skills. Teachers were asked to indicate their frequency of use for each of the 21st century technology tools using a seven point Likert scale: 1 = "Not at All," 2 = "Less Than Once a Month," 3 = "Once a Month," 4 = "Several Times a Month," 5 = "Once a Week," 6 = "Several Times a Week," and 7 = "Daily." After collection and coding of the data, SPSS 16.0 was used to calculate descriptive statistics for each statement. Percentages, frequencies (mode), mean scores, and standard deviations were calculated on each statement for ease of interpretation of the survey.

Participants were asked how often, for instructional purposes, they or their students use 21st century technology tools by indicating a response option that best described their current usage. Table 1 provided frequencies for use of each 21st Century Technology Tool. Based on participants' responses the following tools were reported to be used "Daily" by the majority of West Virginia teachers: Computer (53%), World Wide Web (37%), Word Processing Software (21%), and Email (38%). The majority of respondents reported "Not at All" use for Cell Phone (63%), Classroom Responders (69%), Digital Camera (38%), GIS System (85%), Handheld Computer (69%), iPod (73%), Interactive Whiteboard (57%), Blog (85%), Chat (87%), Distance Learning (75%), Instant Messaging (79%), Podcasts (85%), Virtual Realities (92%), Wikis

(83%),Video Conferencing (90%), Database Software (40%), Desktop Publishing Software (34%), Presentation Software (38%), Spreadsheet Software (48%), Web Authoring Software (78%), Audio Editing Software (84%), Concept Mapping Software (80%), Draw/Paint Software (58%), Image Editing Software (76%), Video Editing Software (82%), Educational Software (20%), and Practice Drills/Tutorials (40%). Bar graphs for each technology tool are displayed in Appendix I.

Table 1. Percentage of Technology Tool Use

21st Century Tools	No response	Not at all	Less than once a month	Once a month	Several times a month	Once a week	Several times a week	Daily
Computer	1%	3%	2%	3%	9%	6%	24%	53%
Cell Phone	1%	63%	4%	1%	1%	2%	4%	23%
Classroom Responders	7%	69%	7%	5%	5%	3%	3%	2%
Digital Camera	1%	38%	22%	12%	13%	6%	6%	2%
GIS System (GPS, etc.)	2%	85%	5%	3%	2%	1%	2%	1%
Handheld Computer (PDA, etc.)	1%	69%	8%	4%	9%	2%	3%	5%
iPod (other mp3 device)	3%	73%	6%	3%	4%	1%	4%	8%
Interactive Whiteboard	2%	57%	14%	6%	5%	4%	6%	7%
World Wide Web	1%	8%	8%	6%	14%	10%	18%	37%
Blog	1%	85%	6%	3%	3%	2%	1%	1%
Chat	2%	87%	4%	1%	1%	1%	2%	2%
Distance Learning (WV Virtual School, WebCT, etc.)	1%	75%	7%	4%	3%	2%	2%	6%
Email	1%	34%	5%	5%	5%	4%	8%	38%
Instant Messaging	1%	79%	3%	2%	3%	1%	4%	6%
Podcasts	3%	85%	6%	3%	2%	1%	0%	0%
Virtual Realities (Second Life, etc.)	2%	92%	3%	2%	1%	1%	0%	0%
Wikis	2%	83%	6%	4%	3%	1%	1%	1%
Video Conferencing	2%	90%	4%	2%	1%	1%	0%	0%
Database Software	2%	40%	11%	10%	11%	6%	12%	8%
Desktop Publishing Software	1%	34%	14%	11%	12%	6%	13%	9%
Presentation Software	2%	38%	18%	13%	12%	6%	6%	6%
Spreadsheet Software	2%	48%	18%	10%	10%	3%	6%	4%
Web Authoring Software	3%	78%	8%	2%	3%	1%	3%	2%
Word Processing Software	1%	20%	7%	8%	17%	7%	20%	21%
Audio Editing Software	1%	84%	8%	2%	3%	1%	1%	1%
Concept Mapping Software	1%	80%	8%	5%	3%	1%.	1%	1%
Draw/Paint Software	1%	58%	17%	8%	9%	3%	3%	2%
Image Editing Software	2%	76%	9%	4%	4%	1%	2%	2%
Video Editing Software	2%	82%	7%	3%	2%	1%	2%	1%
Educational Software	1%	20%	8%	11%	15%	9%	16%	19%
Practice Drills/Tutorials	2%	40%	11%	10%	11%	6%	12%	8%

Although reviewing the percentages for frequency of use provided information about the modes (tool use by the majority of respondents), the researcher looked at other measures of central tendency in order to account for the distribution of responses across technology tool categories. Using the values assigned to each response, descriptive statistics were calculated. The number of participants (N) responding to the questions, the mean (M), standard deviation (SD), and mode are displayed for the following technology tool categories: Hardware Tools (Table 2), Internet Based Tools (Table 3), Application Software Tools (Table 4), Multimedia Tools (Table 5), and Other Tools (Table 6).

Hardware Tools. Participants were asked how often, for instructional purposes, they or their students use 21st century technology by indicating a response option that best described their current usage of 21st Century Technology Hardware Tools (Table 2).

Table 2. Descriptive Data: Hardware Tool Use

Hardware Tools	N	M	SD	Mode
Computer	433	5.98	1.504	7
Cell Phone	431	2.81	2.616	1
Classroom Responders	404	1.74	1.504	1
Digital Camera	431	2.52	1.663	1
GIS System	426	1.30	0.965	1
Handheld Computer	431	1.91	1.657	1
iPod	424	1.93	1.901	1
Interactive Whiteboard	428	2.31	1.966	1
Summation: Hardware Tool Use		2.57	2.247	1

Computer had an M (mean) of 5.98 indicating that teachers on average use a Computer for instructional purposes from "Once a Week" to "Several Times a Week." Cell Phone (2.91), Digital Camera (2.52), and Interactive Whiteboard (2.31), were used on average between "Less than Once a Month" and "Once a Month." Teachers reported using iPod

(1.93), Handheld Computer (1.91), Classroom Responders (1.74), and GIS System (1.30) on average between "Not at All" and "Less than Once a Month."

Cumulatively, 21st Century Hardware Tools had an M (mean) of 2.57 indicating that teachers on average use 21st Century Hardware Tools (Computer, Cell Phone, Classroom Responders, Digital Camera, GIS System, Handheld Computer, iPod, and Interactive Whiteboard) for instructional purposes from "Less Than Once a Month" to "Once a Month." The largest single number of responses (58%) for 21st Century Hardware Tools was found within "Not at All" (Mode = 1).

Internet Based Tools. Participants were asked how often, for instructional purposes, they or their students use 21st century technology by indicating a response option that best described their current usage of 21st Century Internet Based Tools (Table 3).

Table 3. Descriptive Data: Internet Based Tool Use

Internet Based Tools	N	M	SD	Mode
World Wide Web	433	5.13	1.991	7
Blog	432	1.35	1.036	1
Chat	427	1.35	1.185	1
Distance Learning	430	1.74	1.651	1
Email	434	4.15	2.672	7
Instant Messaging	431	1.78	1.787	1
Podcasts	423	1.25	0.770	1
Virtual Realities	429	1.13	0.579	1
Wikis	429	1.37	1.023	1
Video Conferencing	428	1.16	0.657	1
Summation: Internet Based Tool Use		2.05	1.996	1

World Wide Web had an M (mean) of 5.13 indicating that teachers on average use the World Wide Web for instructional purposes from "Once a Week" to "Several Times a Week." Email (4.15) was used on average between "Several Times a Month" and "Once

a Week." Teachers reported using Instant Messaging (1.78), Distance Learning (1.74), Wikis (1.37), Blogs (1.35), Chat (1.35), Podcasts (1.25), Video Conferencing (1.16), and Virtual Realities (1.13) on average between "Not at All" and "Less than Once a Month."

Cumulatively, 21st Century Internet Based Tools had an M (mean) of 2.05 indicating that teachers on average use 21st Century Internet Based Tools (World Wide Web, Blog, Chat, Distance Learning, Email, Instant Messaging, Podcasts, Virtual Realities, Wikis, and Video Conferencing) for instructional purposes from "Less Than Once a Month" to "Once a Month." The largest single number of responses (73%) for 21st Century Internet Based Tools was found within "Not at All" (Mode = 1).

Application Software Tools. Participants were asked how often, for instructional purposes, they or their students use 21st century technology by indicating a response option that best described their current usage of 21st Century Application Software Tools (Table 4).

Table 4. Descriptive Data: Application Software Tool Use

Application Software Tools	N	M	SD	Mode
Database Software	428	2.98	2.126	1
Desktop Publishing Software	432	3.15	2.109	1
Presentation Software	428	2.71	1.878	1
Spreadsheet Software	429	2.37	1.776	1
Web Authoring Software	425	1.52	1.332	1
Word Processing Software	432	4.29	2.191	7
Summation: Application Software Tool Use		2.84	2.097	1

Word Processing Software had an M (mean) of 4.29 indicating that teachers on average use Word Processing Software for instructional purposes from "Several Times a Month" to "Once a Week." Desktop Publishing Software (3.15) was used on average between "Once a Month" and "Several Times a Month." Teachers reported using Database

Software (2.98), Presentation Software (2.71), and Spreadsheet Software (2.37) on average between "Less than Once a Month" and "Once a Month" and Web Authoring Software (1.52) between "Not at All" and "Less than Once a Month."

Cumulatively, 21st Century Application Software Tools had an M (mean) of 2.84 indicating that teachers on average use 21st Century Application Software Tools (Database Software, Desktop Publishing Software, Presentation Software, Spreadsheet Software, Web Authoring Software, and Word Processing Software) for instructional purposes from "Less Than Once a Month" to "Once a Month." The largest single number of responses (44%) for 21st Century Application Software Tools was found within "Not at All" (Mode = 1).

Multimedia Tools. Participants were asked how often, for instructional purposes, they or their students use 21st century technology by indicating a response option that best described their current usage of 21st Century Multimedia Tools (Table 5).

Table 5. Descriptive Data: Multimedia Tool Use

Multimedia Tools	N	M	SD	Mode
Audio Editing Software	431	1.32	0.972	1
Concept Mapping Software	430	1.39	0.980	1
Draw/Paint Software	431	1.97	1.487	1
Image Editing Software	426	1.55	1.306	1
Video Editing Software	427	1.38	1.086	1
Summation: Multimedia Tool Use		1.52	1.206	1

All tools in the Multimedia Tools category fell within the same range – Draw/Paint Software (1.97), Image Editing Software (1.55), Concept Mapping Software (1.39), Video Editing Software (1.38), and Audio Editing Software (1.32) – indicating that teachers on average use these tools for instructional purposes from "Not At All" to "Less Than Once a Month."

Cumulatively, 21st Century Multimedia Tools had an M (mean) of 1.52 indicating that teachers on average use 21st Century Multimedia Tools (Audio Editing Software, Concept Mapping Software, Draw/Paint Software, Image Editing Software, and Video Editing Software) for instructional purposes from "Not at All" to "Less Than Once a Month." The largest single number of responses (77%) for 21st Century Multimedia Tools was found within "Not at All" (Mode = 1).

Other Tools. Participants were asked how often, for instructional purposes, they or their students use 21st century technology by indicating a response option that best described their current usage of Other Technology Tools (Table 6).

Table 6. Descriptive Data: Other Technology Tool Use

Other Tools	N	M	SD	Mode
Educational Software	430	4.09	2.183	1
Practice Drills/Tutorials	416	3.48	2.186	1
Summation: Other Tool Use		3.79	2.205	1

Educational Software had an M (mean) of 4.09 indicating that teachers on average use Educational Software for instructional purposes from "Several Times a Month" to "Once a Week." Practice Drills/Tutorials (3.48) were used on average for instructional purposes from "Once a Month" to "Several Times a Month."

Cumulatively, Other Technology Tools had an M (mean) of 3.79 indicating that teachers on average use Other Technology Tools (Educational Software and Practice Drills/Tutorials) for instructional purposes from "Once a Month" to "Several Times a Month." The largest single number of responses (27%) for Other Technology Tools was found within "Not at All" (Mode = 1).

Summary of Research Question One. This section presented the statistical analyses of the data collected from section one of the *West Virginia Teachers' Technology Tools and Use Survey*. Respondents used a seven point Likert scale to identify how often they integrate 21st century technology tools. Percentages, frequencies (modes), mean scores, and standard deviations were calculated for each statement. Based on analysis of modes, the majority of West Virginia teachers reported "Daily" (7) use of Computers, the World Wide Web, Email, and Word Processing. The majority of respondents reported "Not at All" (1) for the 27 remaining 21st century technology tools.

Other measures of central tendency (M) were calculated to account for variability in responses. Mean scores for the level of use of 21st century technology tools ranged from 5.98 ("Several Times a Week") for Computer to 1.13 ("Not at All") for Virtual Reality. On average (M) West Virginia teachers reported integrating Computers and the World Wide Web from "Once a Week" to "Several Times a Week"; Email, Word Processing Software, and Educational Software from "Several Times a Month" to "Once a Week"; Desktop Publishing and Practice Drills/Tutorials from "Once a Month" to "Several Times a Month"; Cell Phone, Digital Camera, Interactive Whiteboard, Database Software, Presentation Software, and Spreadsheet Software from "Less Than Once a Month" to "Once a Month." Average (M) reported use for the remaining 18 tools ranged from "Not at All" to "Less Than Once a Month."

Technology tools were also grouped and analyzed by categories - Hardware Tools, Internet Based Tools, Application Software Tools, Multimedia Tools, and Other Technology Tools. Cumulative data within each category indicates that the majority (mode) of West Virginia teachers reported "Not at All" (1). Mean scores calculated to

account for variability in responses show that on average Other Tools (3.79) are used most often (from "Once a Month" to "Several Times a Month"), followed by Applications Software Tools (2.84), Hardware Tools (2.57), and Internet Based Tools (2.05) used between "Less Than Once a Month" and "Once a Month." Based on these five categories, Multimedia Tools (1.52) are used least often, from "Not at All" to "Less Than Once a Month."

A summation of mean, mode, and standard deviation scores was calculated across all 31 of the 21st century technology tools (Table 7). The cumulative mode (1) indicates that the majority of West Virginia teachers selected "Not at All" when asked how often they integrate 21st century technology tools. Further analysis, using mean scores to account for variability in responses, shows that on average (2.36) West Virginia teachers use 21st century technology tools from "Less Than Once a Month" to "Once a Month."

Table 7. Descriptive Data: Summation of 21st Century Technology Tool Use

21st Century Technology Tools	M	SD	Mode
Summation: 21st Century Tool Use	2.36	2.078	1

Research Question Two: 21st Century Context for Learning

Based on a review of literature, Section 2, Question 2 of the *West Virginia Teachers' Technology Tools and Use Survey* included 14 questions regarding how often West Virginia PK-12 teachers use 21st century technology tools to create a 21st century context for learning, as identified by the Partnership for 21st Century Skills. Teachers indicated their frequency of use based on the following Likert scale: 1 = "Not at All," 2 = "Less Than Once a Month," 3 = "Once a Month," 4 = "Several Times a Month," 5 = "Once a Week," 6 = "Several Times a Week," and 7 = "Daily." After collection and

coding of the data, SPSS 16.0 was used to calculate descriptive statistics for each statement. Percentages, frequencies (mode), mean scores, and standard deviations were calculated for ease of interpretation of the survey. Section 3, Question 3 of the survey asked teachers to briefly describe a technology related assignment that they frequently ask students to complete. Both quantitative and qualitative findings are reported for research question two.

Participants were asked how often, for instructional purposes, they or their students use 21st century technology tools for activities designed to create a 21st century context for learning. Using the values assigned to each response, descriptive statistics were calculated. Table 8 presents the distribution of responses for each. Locating Internet/Web Resources (18%) was reported to be used "Several Times a Month" by the majority of West Virginia teachers. The majority of respondents reported "Not at All" for Data Collection (31%), Solving Real World Problems (29%), Analyzing and/or Visualizing Data (29%), Demonstrations/Simulations (40%), Playing Educational Real-World Games (46%), Graphical Presentation of Materials (32%), Producing Multimedia Reports/Projects (35%), Webpage Design (76%), Conducting Research (30%), Taking Students on Virtual Field Trips (53%), Collaboration (57%), Communication (65%), and Basic Skill Development/Assessment (28%). Bar graphs for use of technology to create a 21st century context for learning are displayed in Appendix J.

Although reviewing the percentages for frequency of use provided information about the modes (context used by the majority of respondents), the researcher looked at other measures of central tendency in order to account for the distribution of responses.

Table 8. Percentage of Technology Tool Use to Create 21st Century Context

21st Century Tools to Create 21st Century Context	No response	Not at all	Less than once a month	Once a month	Several times a month	Once a week	Several times a week	Daily
Data Collection (calculator, CBL, CBR, GIS, handheld computer, probes, spreadsheet, etc.)	3%	31%	12%	9%	16%	5%	15%	9%
Solving Real-World Problems (calculator, CBL, CBR, GIS, Google Apps, handheld computer, multimedia, probes, simulation, spreadsheet, World Wide Web, etc.)	3%	29%	14%	9%	16%	5%	15%	8%
Analyzing and/or Visualizing Data (calculator, CBL, CBR, GIS, Google Apps, handheld computer, simulation, spreadsheet, World Wide Web, etc.)	4%	29%	14%	8%	15%	8%	13%	9%
Demonstrations/Simulations (dissections, interactions in virtual workplace, videos that connect learning to real world, etc.)	3%	40%	20%	12%	12%	5%	5%	3%
Playing Educational Real-World Games (A.D.A.M., Adventures of Jasper Woodbury, Carmen Sandiego Series, Cluefinders, Mavis Beacon Teaches Typing, Oregon Trail, Reader Rabbit, Zoombini, etc.)	3%	46%	15%	7%	10%	7%	6%	5%
Graphical Presentation of Materials (AutoCAD, Google Apps, Hyperstudio, PowerPoint, Print Shop, etc.)	5%	32%	18%	13%	13%	9%	6%	6%
Producing Multimedia Reports/Projects (PowerPoint, podcasts, videos, etc.)	5%	35%	23%	15%	11%	7%	4%	2%
Webpage Design (FrontPage, Dreamweaver, etc.)	5%	76%	9%	5%	3%	1%	1%	1%
Conducting Research (CD-Rom, Internet, online database)	5%	30%	14%	13%	18%	4%	10%	5%
Taking Students on Virtual Field Trips/Virtual Tours	7%	53%	22%	8%	5%	2%	2%	1%
Collaboration (correspond with experts, authors, students from other schools, etc.)	5%	57%	21%	5%	5%	2%	2%	3%
Communication (online chats, online threaded discussions, online whiteboards, instant messaging, wikis, blogs, podcasts)	5%	65%	11%	6%	4%	2%	3%	4%
Basic Skill Development/ Assessment (CompassLearning, Cornerstone, SkillsBank, CD-ROM games, Internet games, Accelerated Reader, Accelerated Math, etc.)	4%	28%	9%	7%	9%	7%	16%	20%
Locating Internet/Web Resources	6%	13%	10%	12%	18%	11%	18%	13%

Use of 21st Century Tools to Create a 21st Century Context for Learning.

Participants were asked how often, for instructional purposes, they or their students use 21st century technology tools for activities designed to create a 21st century context for learning by indicating a response option that best described their current usage. Using the values assigned to each response, descriptive statistics were calculated. The number of participants responding to the question, the mean (M), standard deviation (SD) and mode are displayed in Table 9.

Analysis of the means revealed that teachers engage students in Locating Internet/Web Resources (4.14) from "Several Times a Month" to "Once a Week." Data Collection (3.35), Solving Real-World Problems (3.34), Analyzing and/or Visualizing Data (3.33), Conducting Research (3.04), and Basic Skill Development/Assessment (3.90) were reportedly used by teachers for instructional purposes on average from "Once a Month" to "Several Times a Month." Demonstrations/Simulations (2.46), Playing Educational Real-World Games (2.54), Graphical Presentation of Materials (2.89), and Producing Multimedia Reports/Projects (2.47) were used on average between "Less than Once a Month" and "Once a Month." Webpage Design (1.43), Taking Students on Virtual Field Trips (1.82), Collaboration (1.85), and Communication (1.85) were used by teachers for instructional purposes on average from "Not at All" to "Less Than Once a Month."

Table 9. Descriptive Data: Use of 21st Century Tools to Create 21st Century Context

21st Century Context	N	M	SD	Mode
Data Collection	427	3.35	2.129	1
Solving Real-World Problems	426	3.34	2.106	1
Analyzing and/or Visualizing Data	424	3.33	2.100	1
Demonstrations/Simulations	427	2.46	1.681	1
Playing Educational Real-World Games	427	2.54	1.920	1
Graphical Presentation of Materials	421	2.89	1.882	1
Producing Multimedia Reports/Projects	421	2.47	1.574	1
Webpage Design	417	1.43	1.086	1
Conducting Research	417	3.04	1.910	1
Taking Students on Virtual Field Trips	409	1.82	1.248	1
Collaboration	421	1.85	1.431	1
Communication	419	1.85	1.612	1
Basic Skill Development/Assessment	422	3.90	2.376	1
Locating Internet/Web Resources	414	4.14	1.979	4
Summation: Creating 21st Century Context		2.75	1.987	1

Cumulatively (2.75), teachers on average engage students in activities designed to use 21st century technology tools to create a 21st century context for learning from "Less Than Once a Month" to "Once a Month." The largest single number of responses (42%) for Creating 21st Century Context for Learning was found within "Not at All" (Mode = 1).

Descriptions of Technology Related Assignments. Section three of the survey allowed teachers to provide further insight and examples of technology use in their classrooms. Teachers were asked to "Briefly describe a technology related assignment that you frequently ask your students to complete." Of the 446 respondents, 327 (73%) provided comments. Assignments supported by word processing, presentations, interactive whiteboards, and calculators were identified most often.

Teachers described word processing assignments such as use of a word processor to type spelling words, type and print a lab report, write a story, or write a research paper.

Teachers reported that they used PowerPoint presentations to deliver content and that they engaged students in designing multimedia presentations. Examples included, "Doing PowerPoint presentations of life skills topics in health class;" "Employment portfolio, career research, vacation planning, and budgeting PowerPoint presentations;" and having students conduct research and prepare a PowerPoint presentation of their findings. Teachers also identified the use of interactive whiteboards for activities such as "daily use to complete reading assignments" or "taking a virtual tour of a 1906 California earthquake." One teacher reported, "I use my whiteboard almost every day. I call it 'teachnology'." Teachers reported using calculators "as appropriate" for "solving math problems in context," "using graphing calculators to solve real world problems," "comparing functions and their graphs," and to "find functions that best fit real world data." Other common uses included integration of Accelerated Reader, Compass Learning, and Odyssey. One theme that emerged was that teachers of all subjects and across all grade levels were able to cite examples of the integration of technology related assignments.

Summary of Research Question Two. This section presented the statistical analyses of the data collected from section two of the *West Virginia Teachers' Technology Tools and Use Survey* along with qualitative data collected from section three of the survey. Respondents used a seven point Likert scale to identify how often they use 21st century technology tools in activities designed to create a 21st century context for learning. Percentages, frequencies (modes), mean scores, and standard deviations were calculated for each statement. Based on analysis of modes, the majority of West Virginia teachers reported Locating Internet/Web Resources "Several Times a Month" (4). The

majority of respondents reported "Not at All" (1) for the 13 remaining 21st century context items.

Other measures of central tendency (M) were calculated to account for variability in responses. Mean scores for the level of use of 21st century technology tools to create a 21st century context for learning ranged from 4.14 ("Several Times a Month") for Locating Internet/Web Resources to 1.43 ("Not at All") for Webpage Design. On average (M) West Virginia teachers reported engaging students in Data Collection, Solving Real-World Problems, Analyzing and/or Visualizing Data, Conducting Research, and Basic Skill Development/Assessment from "Once a Month" to "Several Times a Month." Demonstrations/Simulations, Playing Educational Real-World Games, Graphical Presentation of Materials, and Producing Multimedia Reports/Projects were used on average (M) between "Less Than Once a Month" and "Once a Month." Average (M) reported use for Webpage Design, Taking Students on Virtual Field Trips, Collaboration, and Communication ranged from "Not at All" to "Less Than Once a Month."

A summation of mean, mode, and standard deviation scores was calculated across all 14 items related to using technology tools to create a 21st century context for learning (Table 9). The cumulative mode (1) shows that the majority of West Virginia teachers indicated "Not at All" when asked how often they use 21st century technology tools to create a 21st century context for learning. Further analysis, using a cumulative mean score to account for variability in responses, shows that on average (2.75) West Virginia teachers use 21st century technology tools to create a 21st century context for learning from "Less Than Once a Month" to "Once a Month."

Research Question Three: Influencing Factors

Section 4 and Section 5, Questions 4 and 5 of the *West Virginia Teachers' Technology Tools and Use Survey* included checklists of 26 parallel factors that support or prohibit teachers' use/integration of technology in instruction. Teachers were asked to select supports and barriers that make them successful and/or prevent them from integrating technology in instruction. SPSS 16.0 was used to derive the frequency of checked responses for each of the 26 supports and barriers. Section 6, Question 6 of the survey asked teachers to briefly describe the support or barrier "that is most significant in making you successful and/or preventing you from integrating technology." Both quantitative and qualitative findings are reported for research question three.

Supports for Integrating Technology in Instruction. Participants were asked in the fourth section to respond to 26 factors that support their use of technology in instruction, by answering yes (checking the statement) or no (leaving the statement unchecked). Twelve supports were identified by more than 50% of the 435 respondents. More than 80% of teachers recognized having a computer at home (88%); Internet access at home (88%); access to Internet in their classroom (85%); and access to Internet elsewhere in their school (80%), such as in a computer lab or media center, as factors that support their use of technology in instruction. Between 70-79% recognized their interest in using technology for classroom instruction (72%) and school policy that allows access to email (71%) as supporting factors. Between 60-69% indicated there were enough computers elsewhere in their school (69%) either in a computer lab or the media center. Additionally, 50-59% indicated technology was a priority of the school administration (58%), school policy allowed adequate student/teacher use of technology (58%),

technical support was available at the school level (57%), technology was a priority of district administration (53%), and support was available at district/state/regional level (50%). All other supports mentioned in the literature were identified by fewer than 50% of West Virginia teachers. Table 10 presents frequencies and percentages for factors supporting the use of technology in instruction.

Table 10. Supports for Using Technology in Instruction

Supports	N	Yes	% Yes
Computer at home	435	385	88%
Internet at home	435	375	88%
Access to Internet in classroom	435	371	85%
Access to Internet elsewhere in school	435	346	80%
Interested in using technology for classroom instruction	435	314	72%
School policy allows access to e-mail	435	310	71%
Adequate number of computers elsewhere in school	435	300	69%
Technology priority of school administration	435	253	58%
School policy allows adequate student/teacher use of technology	435	252	58%
Technical support available at school level	435	250	57%
Technology priority of district administration	435	232	53%
Technical support available at district/state/regional level	435	217	50%
Technology in school up-to-date	435	206	47%
Technology priority of school community	435	192	44%
Network storage capability at school	435	185	42%
Adequate technology available for integration	435	160	37%
Adequate professional development in technology usage	435	157	36%
Adequate number of computers in classroom	435	148	34%
Technology supports curriculum/no extra work or effort	435	147	34%
Incentives provided for participating in technology training	435	130	30%
School policy allows access to social networking tools	435	124	28%
Ample funding designated for technology	435	110	25%
Adequate professional development related to content specific	435	102	23%
Ample funding designated for technology related professional	435	101	23%
Adequate follow-up to support technology integration	435	70	16%
Time to explore new technology tools and applications	435	65	15%

Description of Supports. Section 6 of the survey utilized an open response item that asked respondents to briefly describe the most significant supports/barriers in making them successful and/or preventing them from integrating technology. Respondents (274

or 63%) provided a wide range of answers describing factors that both support and prohibit their use of technology in the classroom. Answers ranged from listing specific technology tools available/not available to citing specific examples of technology integration.

When asked to briefly describe one support or barrier that was most significant in making teachers successful and/or preventing them from integrating technology, several teachers indicated having a computer and Internet access at home and Internet access either in their classroom or elsewhere in the school was critical to their success in using technology in instruction. One teacher responded, "Aiding my success in integrating technology is the training I have had access to and being able to spend hours at home on my own computer." Another answered, "The most helpful support is having Internet at school and at home." Yet another simply replied, "Support - Internet access and computer access in school."

While 71% of respondents indicated that school email access supported their instruction, only three described email access as the most significant factor in successful technology integration. One teacher said, "Instead of directly using email, I have the students communicate through http://www.hotchalk.com. It is a free site that has a lot of really innovative features, many of which enable students to communicate with the instructor and their peers in various ways. Everything that they post will clearly be logged under their name." Another respondent further explained, "I've really found Hotchalk.com to be a very useful resource in assisting in giving my classes a WEBCT type feel in certain aspects. It allows students to hold discussions, electronically submit assignments, check their grades, research historical video moments, and much more. It

has been very beneficial in allowing the students to communicate without necessarily dealing with emails."

The issue of funding emerged as both a support and as a barrier. While one respondent claimed, "We are fortunate enough that all of our teachers have laptops. I have my own projector, VCR/DVD unit, and stereo in my classroom. Our entire school has wireless Internet. We have a mobile lab with 24 student laptops, along with two regular computer labs." Others reported, "I think the biggest barrier is regarding the funding and ability to have computers in all the classrooms. Right now we have a hard time scheduling the whole school into one computer lab," and simply, "inadequate funding."

Barriers for Integrating Technology in Instruction. Participants were asked in the fifth section to respond to 26 barriers that prevent them from using technology in their instruction, by answering yes (checking the statement) or no (leaving the statement unchecked). Only two barriers were identified by more than 50% of West Virginia teachers. Of 435 respondents, 278 (64%) indicated that they did not have enough time to explore new technology tools and applications and 246 (56%) indicated the number of computers in their classroom was inadequate. In rank order, ample funding (40%) was the next most significant barrier teachers identified. Table 11 presents the frequency and percentage distribution for barriers to using technology in instruction.

Table 11. Descriptive Data: Barriers to Using Technology in Instruction

Barriers	N	Yes	% Yes
Not enough time to explore new technology tools and applications	435	278	64%
Inadequate number of computers in classroom	435	246	56%
Ample funding is not designated for technology	435	174	40%
Ample funding not designated for technology related professional	435	139	32%
Inadequate follow-up to support technology integration	435	139	32%
Inadequate professional development related to content specific	435	135	31%
Incentives not provided for participating in technology training	435	128	29%
Inadequate professional development in technology usage	435	117	27%
Inadequate technology available for integration	435	103	24%
Technology in school is outdated	435	85	20%
Inadequate number of computers elsewhere in school	435	73	17%
Technology does not support curriculum/creates extra work or effort	435	68	16%
School policy does not allow access to social networking tools	435	61	14%
Technical support not available at school level	435	60	14%
Technical support not available at district/state/regional level	435	34	8%
Technology not a priority of district administration	435	30	7%
Technology not a priority of school community	435	30	7%
School policy does not allow access to e-mail	435	27	6%
School policy does not allow for adequate student/teacher use of	435	27	6%
Technology not a priority of school administration	435	27	6%
No Internet at home	435	24	6%
Network storage capability does not exist at school	435	20	5%
No computer at home	435	14	3%
Not interested in using technology for classroom instruction	435	9	2%
No access to Internet in classroom	435	15	2%
No access to Internet elsewhere in school	435	3	1%

Description of Barriers. Section 6 also asked respondents to briefly describe the most significant barriers preventing them from integrating technology. Respondents provided a wide range of answers from listing technology tools available/not available to citing specific examples of technology integration.

Although 69% of teachers responding to the survey indicated there was an adequate number of computers in their school, only 34% indicated an adequate number in their classroom. In fact, 106 (38.7%) of the written comments regarding supports and barriers indicated that computer access was a barrier, not a support. One teacher

responded, “I have one computer in my classroom which is located across the school campus from the computer lab. I do not even have basic equipment in my room.” Another echoed this sentiment, “Computers in the classroom are out of date and don’t work correctly most of the time - limited number of computers in the classroom.” Another teacher responded, “Computers are outdated/slow,” and still another, “Access to computers; we have two labs but can only access them about once a month.”

The most frequently selected barrier can be categorized as “time.” Teachers described this challenge using general responses, “TIME!!” and more specific responses, “Time for professional development.” Other respondents elaborated, “There is a significant lack of time to prepare lessons using technology. We are often given training and then told to go use it. There is no time to implement what we learn briefly in workshops,” and “Time is needed to integrate technology into existing lesson plans and to explore new programs and devices.”

Summary of Research Question Three. This section presented the statistical analyses of the data collected from the *West Virginia Teachers’ Technology Tools and Use Survey* that utilized yes-no response items to identify the supports and barriers that make West Virginia PK-12 teachers successful and/or prevent them from integrating technology in instruction. Percentages for each yes response related to support and barrier statements were calculated. SPSS 16.0 was used to derive the frequency/percentage distributions.

The supports that make West Virginia PK-12 teachers successful in the integration of technology in instruction include: a computer at home (88%); Internet access at home (88%); access to Internet in the classroom (85%); access to Internet

elsewhere in the school (79%), such as in a computer lab or media center; interest in using technology for classroom instruction (72%); school policy that allows access to email (71%); enough computers elsewhere in the school (69%), either in a computer lab or the media center; school administration that makes technology a priority (58%); school policy that allows adequate student/teacher use of technology (58%); technical support available at the school level (57%); district administration that makes technology a priority (53%); and technical support available at district/state/regional level (50%).

The most frequently identified barriers that prevent West Virginia PK-12 teachers from being successful in the integration of technology in instruction include not enough time to explore new technology tools and applications (64%) and inadequate number of computers in the classroom (56%). Responses to checklists of supports/barriers were supported by written comments. One-hundred twenty teachers described challenges related to the barrier, "not enough time to explore" including, "I believe 'time' is my biggest enemy in using more technology. I would do even more activities if I didn't have to search for the resources," "We simply do not have the time to explore tech and it creates much extra work on my part which there is no time for," and basically, "Time to learn. We are with human beings. We are not office workers, kids are everywhere!" Seventy-one teachers commented on the barrier "inadequate number of computers in the classroom." Typical written comments referred to the number of computers in the classroom including, "More computers are needed in my classroom," "The biggest concern is lack of enough computers in the classroom," and "Need for more computers in my classroom."

Ancillary Findings

In Section 7, the *West Virginia Teachers' Technology Tools and Use Survey* collected demographic data from respondents, including: age range, current grade level(s) taught, current subject(s) taught, years experience as a full time teacher, if they had participated in technology use/integration professional development in the last three years, if they had completed any online courses/workshops in the last three years, if they had participated in specific technology related training/activities in the last three years, and the percentage of students in their school who receive free or reduced lunch.

The demographic data were analyzed across groups. Kruskal-Wallis was used to determine if any significant differences existed between the variables and the demographic data. This test of significance was selected because Kruskal-Wallis is viewed as the nonparametric counterpart for the One-Way Analysis of Variance or ANOVA. The value $p < 0.05$ was used to determine significance.

Analysis between the demographic data and how often teachers use 21st century technology tools revealed statistical significance based on age range, grade level(s) taught, current subject(s) taught, years experience, and percentage of students who receive free or reduced lunch. Analysis between demographic data and how often teachers use 21st century technology tools to create a 21st century context for learning revealed statistical significance based on age range, grade level(s) taught, current subject(s) taught, years experience, and percentage of students who receive free or reduced lunch. There was no statistical significance in differences based on years experience. Supporting details are discussed in the sections that follow.

Age Group

In terms of age range, 61 respondents (14%) were in the 20-30 age group, 90 respondents (20%) were in the 31-40 age group, 96 respondents (22%) were in the 41-50 age group, 156 respondents (35%) were in the 51-60 age group, and 20 respondents (5%) were in the 61+ age group, for a total of 423 respondents. Twenty-three participants (5%) did not specify an age range.

The Kruskal-Wallis test revealed significance between the respondents' ratings of the level of use of 21st century technology tools and age group. Significance between age groups and frequency of use was found for six of the 31 technology tools, including: iPod ($p=.024$), World Wide Web ($p=.042$), Email ($p=.029$), Draw/Paint Software ($p=.038$), Educational Software ($p=.007$) and Practice Drills/Tutorials ($p=.029$). Table 12 presents the levels of significance.

Table 12. Significance between Technology Tool Use and Age Group

Tools	Chi-Square	df	Asymp. Sig
Computer	4.031	4	.402
Cell Phone	7.983	4	.092
Classroom Responders	7.870	4	.096
Digital Camera	6.559	4	.161
GIS System	4.307	4	.366
Handheld Computer	1.925	4	.750
iPod	11.284	4	*.024
Interactive Whiteboard	6.426	4	.169
World Wide Web	9.892	4	*.042
Blog	3.455	4	.485
Chat	4.505	4	.342
Distance Learning	6.419	4	.170
Email	10.833	4	*.029
Instant Messaging	5.194	4	.268
Podcasts	2.064	4	.724
Virtual Realities	.959	4	.916
Wikis	3.098	4	.542
Video Conferencing	3.989	4	.407
Database Software	5.200	4	.267
Desktop Publishing Software	1.169	4	.883
Presentation Software	4.744	4	.315
Spreadsheet Software	2.721	4	.605
Web Authoring Software	4.381	4	.357
Word Processing Software	3.562	4	.469
Audio Editing Software	4.162	4	.385
Concept Mapping Software	5.555	4	.235
Draw/Paint Software	10.135	4	*.038
Image Editing Software	7.393	4	.117
Video Editing Software	6.943	4	.139
Educational Software	14.244	4	*.007
Practice Drills/Tutorials	10.755	4	*.029

*Significant at the 0.05 level.

Analysis of mean rank scores was completed to discover the nature of the statistical significance between age groups and frequency of use for the six 21st century technology tools for which statistically significant differences were found. The greater the mean rank score, the greater the level of use of technology tools by the group. Further analysis of mean rank scores based on age groups and their technology tool use revealed that: 1) the 20-30 age group is using four of the six 21st century technology tools less often than all other age groups (Email, Draw-Paint Software, Educational Software, and Practice Drills/Tutorials), and 2) the 61+ age group is using five of the six tools more

often than the others although the N for this group is small and may not be generalizable. Table 13 outlines mean rank scores for tools having significant differences in use based on age group.

Table 13. Mean Rank Scores between Technology Tool Use and Age Group

Tools	Age Range				
	20-30	31-40	41-50	51-60	61+
iPod	211.62	216.62	215.76	189.56	247.00
World Wide Web	211.63	221.84	214.84	193.94	274.28
Email	193.60	204.79	221.10	205.65	284.72
Draw-Paint Software	182.41	235.73	198.93	213.54	213.34
Educational Software	158.16	220.97	209.58	222.36	225.45
Practice Drills/Tutorials	172.90	196.71	193.00	219.38	246.45

The Kruskal-Wallis test revealed no significant differences between the respondents' rating of the level of use of 21st century technology tools to create a 21st century context for learning and age group.

Current Grade Level

In terms of current grade level, 79 respondents (18%) indicated teaching at the PK-2 grade level, 71 respondents (16%) identified grades 3-5, 87 respondents (20%) taught grades 6-8, 115 respondents (26%) indicated teaching grades 9-12, and 74 respondents (17%) indicated serving multiple grade level groups, for a total of 426 respondents. Twenty (5%) did not specify the current grade level(s) taught.

The Kruskal-Wallis test revealed significance between the respondents' ratings of the level of use of 21st century technology tools and grade level taught. Significance between grade level taught and frequency of use was found for nine of the 31 technology tools, including: Digital Camera (p=.040), Handheld Computer (p=.000), Interactive Whiteboard (p=.036), World Wide Web (p=.036), Presentation Software (p=.000), Spreadsheet Software (p=.000), Draw/Paint Software (p=.034), Educational Software

(p=.000), and Practice Drills/Tutorials (p=.000). Table 14 presents the levels of significance.

Table 14. Significance between Technology Tool Use and Grade Level

Tools	Chi-Square	df	Asymp. Sig
Computer	8.946	4	.062
Cell Phone	3.268	4	.514
Classroom Responders	8.184	4	.085
Digital Camera	10.051	4	*.040
GIS System	4.509	4	.341
Handheld Computer	33.338	4	*.000
iPod	4.875	4	.300
Interactive Whiteboard	12.484	4	*.036
World Wide Web	10.298	4	*.036
Blog	9.232	4	.056
Chat	3.920	4	.417
Distance Learning	6.443	4	.168
Email	3.633	4	.458
Instant Messaging	3.179	4	.528
Podcasts	4.990	4	.288
Virtual Realities	6.943	4	.139
Wikis	8.882	4	.064
Video Conferencing	5.334	4	.255
Database Software	6.462	4	.167
Desktop Publishing Software	4.570	4	.334
Presentation Software	36.962	4	*.000
Spreadsheet Software	24.115	4	*.000
Web Authoring Software	8.831	4	.065
Word Processing Software	9.250	4	.055
Audio Editing Software	8.072	4	.089
Concept Mapping Software	6.037	4	.196
Draw/Paint Software	10.419	4	*.034
Image Editing Software	6.296	4	.178
Video Editing Software	4.918	4	.296
Educational Software	36.523	4	*.000
Practice Drills/Tutorials	31.642	4	*.000

*Significant at the 0.05 level.

Analysis of mean rank scores was completed to discover the nature of the statistical significance between grade level taught and frequency of use for the nine 21st century technology tools. The greater the mean rank score, the greater the level of use of technology tools by the group. Further analysis of mean rank scores based on grade level taught and technology tool use revealed that: 1) teachers of grades 3-5 are using six of the nine technology tools - Digital Camera, Interactive Whiteboards, World Wide Web,

Draw/Paint Software, Educational Software, and Practice Drills/Tutorials more often than all other grade level groups; 2) teachers of grades 6-8 do the least with five of the nine technology tools - Digital Camera, Handheld Computer, Draw/Paint Software, Educational Software, and Practice Drills/Tutorials; and 3) PK-2 teachers use the World Wide Web, Presentation Software, and Spreadsheet Software significantly less than other groups. Table 15 outlines mean rank scores for tools having significant differences in use based on grade level.

Table 15. Mean Rank Scores between Technology Tool Use and Grade Level

Tools	Grade Level Taught				
	PK-2	3-5	6-8	9-12	Multiple
Digital Camera	231.58	235.41	185.09	203.81	207.43
Handheld Computer	263.54	221.84	187.60	188.82	208.55
Interactive Whiteboards	195.43	246.44	213.87	206.06	188.71
World Wide Web	189.21	236.79	190.44	224.36	218.42
Presentation Software	142.25	213.18	223.42	244.98	211.29
Spreadsheet Software	156.69	206.41	235.07	228.06	215.21
Draw/Paint Software	220.62	240.03	186.63	205.36	215.99
Educational Software	239.48	275.42	174.21	196.83	188.94
Practice Drills/Tutorials	208.49	273.35	182.13	184.98	191.18

The Kruskal-Wallis test also revealed significance between the respondents' ratings of the level of use of 21st century technology tools to create a 21st century context for learning and grade level taught. Significance between grade level taught and frequency of using technology to create a 21st century context for learning was found for 10 of the 14 areas, including: Data Collection (p=.006), Solving Real-World Problems (p=.000), Analyzing and/or Visualizing Data (p=.000), Demonstrations/Simulations (p=.000), Playing Educational Real-World Games (p=.000), Graphical Presentation of Materials (p=.000), Producing Multimedia Reports (p=.000), Conducting Research (p=.000), Taking Students on Virtual Field Trips (p=.001), and Basic Skill Development/Developing Assessment (p=.000). Table 16 presents the levels of significance.

Table 16. Significance between Technology Tool Use to Create 21st Century Context and Grade Level

Tools	Chi-Square	df	Asymp. Sig
Data Collection	14.313	4	*.006
Solving Real-World Problems	23.771	4	*.000
Analyzing and/or Visualizing Data	22.498	4	*.000
Demonstrations/Simulations	20.219	4	*.000
Playing Real-World Educational Games	46.090	4	*.000
Graphical Presentation of Materials	23.078	4	*.000
Producing Multimedia Reports/Projects	47.151	4	*.000
Webpage Design	5.615	4	.230
Conducting Research	26.789	4	*.000
Taking Students on Virtual Field Trips	17.582	4	*.001
Collaboration	6.790	4	.147
Communication	8.070	4	.089
Basic Skill Development/Assessment	94.797	4	*.000
Locating Internet/Web Resources	4.545	4	.337

*Significant at the 0.05 level.

Further analysis of mean rank scores (Table 17) revealed that: 1) students/teachers in grades 3-5 do more with Analyzing and/or Visualizing Data, Playing Educational Real-World Games, Taking Students on Virtual Field Trips, and Basic Skill Development/Assessment; 2) students/teachers in grades 9-12 use technology tools to create a 21st century context for learning more than others by Solving Real-World Problems, Demonstrations/Simulations, Graphical Presentation of Materials, Producing Multimedia Reports, and Conducting Research; and 3) students/teachers in grades PK-2 use technology tools to create a 21st century context for learning less than others in seven areas: Data Collection, Solving Real-World Problems, Analyzing and/or Visualizing Data, Demonstrations/Simulations, Graphical Presentation of Materials, Producing Multimedia Reports, and Conducting Research.

Table 17. Mean Rank Scores between Technology Tool Use to Create 21st Century Context and Grade Level

Context	Grade Level Taught				
	PK-2	3-5	6-8	9-12	Multiple
Data Collection	170.34	230.60	231.85	218.80	204.78
Solving Real-World Problems	159.01	232.03	226.03	233.66	195.97
Analyzing and/or Visualizing Data	157.51	232.29	223.78	229.84	199.87
Demonstrations/Simulations	168.66	232.82	220.63	235.25	191.78
Playing Educational Real-World Games	240.89	273.01	207.84	163.24	202.37
Graphical Presentation of Materials	155.97	222.26	220.87	233.97	200.67
Producing Multimedia Reports	141.97	194.99	225.11	256.17	203.14
Conducting Research	153.45	228.51	208.95	237.43	195.17
Taking Students on Virtual Field Trips	198.61	250.56	191.14	191.65	191.44
Basic Skill Development/Assessment	267.76	291.40	190.53	139.79	196.46

Current Subject Taught

Participants were asked what subject they currently teach. Responses were selected from ten choices. In terms of subject taught, 81 respondents (18%) taught in a Self-contained classroom, 31 (7%) taught English/Language Arts, 26 (6%) taught Math, 16 (4%) taught Science, 21 (5%) taught Social Studies, 3 (1%) taught Foreign Language, 29 (7%) taught Fine Arts, 17 (4%) taught PE/Health, 27 (6%) taught Special Education, 52 (12%) taught other subjects, and 124 (28%) reported teaching multiple subjects, for a total of 424 respondents. Twenty-two participants (5%) did not report the current subject taught.

The Kruskal-Wallis test revealed significance between the respondents' ratings of the level of use of 21st century technology tools and current subject taught. Significance between subject taught and frequency of use was found for 15 of the 31 technology tools, including: Computer (p=.002), Digital Camera (p=.041), Handheld Computer (p=.002), iPod (p=.004), Interactive Whiteboard (p=.017), World Wide Web (p=.004), Desktop Publishing Software (p=.039), Presentation Software (p=.001), Spreadsheet Software (p=.022), Word Processing Software (p=.025), Audio Editing Software (p=.005), Draw/Paint Software (p=.045), Image Editing Software (p=.018), Educational Software

(p=.000), and Practice Drills/Tutorials (p=.000). Table 18 presents the levels of significance.

Table 18. Significance between Technology Tool Use and Subject Taught

Tools	Chi-Square	df	Asymp. Sig
Computer	26.129	9	*.002
Cell Phone	11.601	9	.237
Classroom Responders	15.464	9	.079
Digital Camera	17.498	9	*.041
GIS System	11.548	9	.240
Handheld Computer	26.633	9	*.002
iPod	24.382	9	*.004
Interactive Whiteboard	20.099	9	*.017
World Wide Web	23.902	9	*.004
Blog	15.941	9	.068
Chat	2.141	9	.989
Distance Learning	15.780	9	.072
Email	13.996	9	.122
Instant Messaging	6.705	9	.668
Podcasts	4.441	9	.880
Virtual Realities	13.562	9	.139
Wikis	3.628	9	.934
Video Conferencing	16.040	9	.066
Database Software	13.065	9	.160
Desktop Publishing Software	17.691	9	*.039
Presentation Software	29.523	9	*.001
Spreadsheet Software	19.364	9	*.022
Web Authoring Software	9.391	9	.402
Word Processing Software	19.028	9	*.025
Audio Editing Software	23.456	9	*.005
Concept Mapping Software	15.516	9	.078
Draw/Paint Software	17.239	9	*.045
Image Editing Software	19.936	9	*.018
Video Editing Software	12.471	9	.188
Educational Software	52.230	9	*.000
Practice Drills/Tutorials	37.209	9	*.000

*Significant at the 0.05 level.

Analysis of mean rank scores was completed to discover the nature of the statistical significance between subject taught and frequency of use for 15 of the 21st century technology tools. The greater the mean rank score, the greater the level of use of technology tools by the group. Further analysis of mean rank scores based on subject taught and their technology tool use revealed that: 1) the Special Education group is using World Wide Web, Spreadsheet Software, and Educational Software more often than

teachers in any other group; 2) the Social Studies group is using iPod, Interactive Whiteboard, Presentation Software, and Word Processing Software more than any other group; 3) the Self-contained group is using Digital Camera, Handheld Computer, Desktop Publishing Software, and Practice Drills/Tutorials more than any other group; 4) the Math group is using Word Processing Software less often than teachers in other subject area groups; 5) the PE/Health group is using seven of the 21st century technology tools less often than teachers in other subject area groups, including: Digital Camera, Interactive Whiteboard, World Wide Web, Desktop Publishing Software, Presentation Software, Audio Editing Software, and Educational Software; and 6) the Other subject group is using Computer, Draw/Paint Software, and Image Editing Software more often than any other group. Table 19 outlines mean rank scores for tools having significant differences in use based on subject taught.

Table 19 . Mean Rank Scores between Technology Tool Use and Subject Taught

Tools	Subject Taught									
	Spec. Ed	Self-Cont.	Eng LA	Math	Science	Social Studies	Fine Arts	PE Health	Other	Multiple
Computer	220.98	232.42	147.28	158.22	168.44	220.86	187.86	196.30	236.76	219.05
Digital Camera	216.41	239.53	166.36	197.98	217.88	173.34	234.78	163.79	227.02	198.68
Handheld Computer	225.39	254.59	169.16	202.44	197.53	217.93	208.64	181.14	187.78	202.23
iPod	215.04	205.16	177.30	208.40	220.56	215.98	278.17	200.82	195.18	196.38
Interactive Whiteboard	239.31	208.17	182.14	238.92	219.62	251.66	160.57	147.61	200.08	212.18
World Wide Web	237.43	214.06	154.71	186.08	214.00	240.30	186.29	118.27	225.62	224.98
Desktop Publishing Software	228.20	228.65	173.90	181.04	180.43	194.95	179.31	142.10	223.35	224.57
Presentation Software	248.48	178.10	199.33	230.69	276.06	277.61	189.83	173.27	231.58	195.34
Spreadsheet Software	248.42	183.33	158.93	224.31	247.19	223.79	223.91	246.54	226.26	201.91
Word Processing Software	233.37	204.56	180.79	139.64	226.59	237.77	210.17	154.30	232.17	219.84
Audio Editing Software	216.09	194.13	206.40	202.13	228.44	207.29	267.43	193.53	216.36	205.29
Draw/Paint Software	223.84	227.40	164.52	167.67	198.34	204.36	208.04	173.50	239.13	210.85
Image Editing Software	228.39	196.90	173.41	201.02	236.47	207.86	235.02	206.60	237.71	196.33
Educational Software	254.11	251.79	170.83	167.62	198.09	152.77	130.84	106.93	227.53	225.80
Practice Drills/Tutorials	211.92	241.88	137.93	209.48	206.56	157.60	136.34	141.61	210.50	216.16

The Kruskal-Wallis test also revealed significance between the respondents' ratings of the level of use of 21st century technology tools to create a 21st century context for learning and current subject taught. Significance was found for eight of the 14 areas, including: Data Collection (p=.001), Solving Real-World Problems (p=.000), Analyzing and/or Visualizing Data (p=.0012), Playing Educational Real-World Games (p=.000), Graphical Presentation of Materials (p=.000), Producing Multimedia Reports (p=.000), Basic Skill Development/Assessment (p=.000), and Locating Internet/Web Resources (p=.009). Table 20 presents the levels of significance.

Table 20. Significance between Technology Tool Use to Create 21st Century Context and Subject Taught

Context	Chi-Square	df	Asymp. Sig
Data Collection	27.237	9	*.001
Solving Real-World Problems	37.116	9	*.000
Analyzing and/or Visualizing Data	21.084	9	*.012
Demonstrations/Simulations	12.086	9	.208
Playing Real-World Educational Games	48.151	9	*.000
Graphical Presentation of Materials	29.766	9	*.000
Producing Multimedia Reports/Projects	45.838	9	*.000
Webpage Design	5.851	9	.755
Conducting Research	12.814	9	.181
Taking Students on Virtual Field Trips	15.320	9	.083
Collaboration	16.487	9	.057
Communication	11.051	9	.272
Basic Skill Development/Assessment	94.556	9	*.000
Locating Internet/Web Resources	21.891	9	*.009

*Significant at the 0.05 level.

Further analysis of mean rank scores (Table 21) revealed that: 1) students/teachers in Math classes use Data Collection, Solving Real-World Problems, and Analyzing and/or Visualizing Data more than others; 2) students/teachers in Social Studies classes use Graphical Presentation of Materials and Producing Multimedia Reports more than others; 3) students/teachers in Special Education classes use Playing Educational Real-World Games and Locating Internet/Web Resources more than others; and 4) students/teachers in Self-contained classes use Basic Skill Development/Assessment more than others.

Table 21. Mean Rank Scores between Technology Tool Use to Create 21st Century Context and Subject Taught

Context	Subject Taught									
	Spec. Ed	Self-Cont.	Eng LA	Math	Science	Social Studies	Fine Arts	PE Health	Other	Multiple
Data Collection	236.13	190.06	163.82	280.71	245.72	186.55	161.88	210.21	206.58	227.77
Solving Real-World Problems	239.81	185.14	167.84	297.31	212.56	203.14	142.41	186.88	213.90	230.80
Analyzing and/or Visualizing Data	216.08	187.49	173.84	275.96	242.31	231.76	161.79	200.88	219.16	216.35
Playing Educational Real-World Games	255.69	247.04	190.85	187.92	133.72	174.14	125.07	154.65	207.43	231.58
Graphical Presentation of Materials	252.26	183.19	204.73	187.27	218.57	290.95	171.31	163.38	247.33	203.50
Producing Multimedia Reports	225.27	155.22	233.42	210.33	273.30	298.71	189.14	224.41	249.82	194.05
Basic Skill Development/ Assessment	226.67	285.86	186.47	186.60	135.80	147.21	109.02	102.12	169.23	237.51
Locating Internet Web Resources	256.71	214.83	167.40	155.24	190.90	197.08	158.21	175.56	217.97	220.09

Years Experience as Full Time Teacher

Participants were asked how many years experience they had as a full time teacher. Responses were divided into eight categories. In terms of years experience as a full time teacher, 86 respondents (20%) indicated 0-5 years experience, 66 respondents (15%) had 6-10 years experience, 53 respondents (12%) had 11-15 years experience, 32 respondents (7%) indicated 16-20 years experience, 47 respondents (11%) had 21-25 years experience, 64 respondents (14%) had 26-30 years experience, 61 respondents (14%) had 31-35 years experience, and 17 respondents (4%) had 36+ years experience, for a total of 426 respondents. Twenty (5%) did not specify the number of years experience as a full time teacher.

The Kruskal-Wallis test revealed significance between the respondents' ratings of the level of use of 21st century technology tools and years experience as a full time teacher. Significance was found for three of the 31 technology tools, including: Image Editing (p=.033), Educational Software (p=.020), and Practice Drills/Tutorials (p=.029). Table 22 presents the levels of significance.

Table 22. Significance between Technology Tool Use and Years Experience

Tools	Chi-Square	df	Asymp. Sig
Computer	9.302	7	.232
Cell Phone	9.718	7	.205
Classroom Responders	5.598	7	.587
Digital Camera	6.933	7	.436
GIS System	6.092	7	.529
Handheld Computer	9.260	7	.235
iPod	5.436	7	.607
Interactive Whiteboard	9.636	7	.210
World Wide Web	12.581	7	.083
Blog	7.398	7	.389
Chat	3.175	7	.868
Distance Learning	6.985	7	.430
Email	12.199	7	.094
Instant Messaging	4.746	7	.691
Podcasts	8.745	7	.272
Virtual Realities	6.112	7	.527
Wikis	10.451	7	.164
Video Conferencing	9.008	7	.252
Database Software	8.530	7	.288
Desktop Publishing Software	9.236	7	.236
Presentation Software	6.046	7	.534
Spreadsheet Software	4.525	7	.718
Web Authoring Software	4.604	7	.708
Word Processing Software	11.779	7	.108
Audio Editing Software	9.443	7	.222
Concept Mapping Software	8.620	7	.281
Draw/Paint Software	4.401	7	.733
Image Editing Software	15.239	7	*.033
Video Editing Software	11.711	7	.110
Educational Software	16.672	7	*.020
Practice Drills/Tutorials	15.584	7	*.029

*Significant at the 0.05 level.

Analysis of mean rank scores was completed to discover the nature of the statistical significance between years experience and frequency of use for the three 21st century technology tools. The greater the mean rank score, the greater the level of use of

technology tools by the group. Further analysis of mean rank scores based on years experience and their technology tool use revealed that teachers with 0-5 years experience are using two of the three 21st century technology tools less often than other groups (Educational Software and Practice Drills/Tutorials). Table 23 outlines mean rank scores for tools having significant differences in use based on years experience.

Table 23. Mean Rank Scores between Technology Tool Use and Years Experience

Tools	Years Experience							
	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36+
Image Editing Software	197.53	213.35	215.49	237.29	209.34	229.30	179.38	210.09
Educational Software	173.06	213.42	209.42	244.71	247.25	227.12	203.11	207.53
Practice Drills/Tutorials	168.73	201.14	204.81	225.86	206.29	219.84	209.35	270.97

The Kruskal-Wallis test also revealed significance between the respondents' ratings of the level of use of 21st century technology tools to create a 21st century context for learning and years experience as a full time teacher. Significance was found in one of the 14 areas, Taking Students on Virtual Field Trips (p=.029). Table 24 presents the levels of significance.

Table 24. Significance between Technology Tool Use to Create 21st Century Context and Years Experience

Context	Chi-Square	df	Asymp. Sig
Data Collection	4.008	7	.779
Solving Real-World Problems	2.504	7	.927
Analyzing and/or Visualizing Data	9.552	7	.215
Demonstrations/Simulations	9.223	7	.237
Playing Real-World Educational Games	9.132	7	.321
Graphical Presentation of Materials	7.143	7	.414
Producing Multimedia Reports/Projects	7.861	7	.345
Webpage Design	6.426	7	.491
Conducting Research	9.794	7	.201
Taking Students on Virtual Field Trips	15.580	7	*.029
Collaboration	9.744	7	.204
Communication	11.913	7	.103
Basic Skill Development/Assessment	13.639	7	.058
Locating Internet/Web Resources	6.379	7	.496

*Significant at the 0.05 level.

Further analysis of mean rank scores (Table 25) revealed that teachers with 21-25 years experience use Taking Students on Virtual Field Trips more than any other group.

Table 25. Mean Rank Scores between Technology Tool Use to Create 21st Century Context and Years Experience

Context	Years Experience							
	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36+
Taking Students on Virtual Field Trips	194.98	203.19	177.07	205.20	250.21	216.93	182.38	212.31

Professional Development in Technology Use/Integration in the Last Three Years

Participants were asked whether or not they had participated in professional development in technology use/integration in the last three years. A majority of respondents had participated in technology related professional development. Of the 446 participants, 383 respondents (88%) had participated in professional development in technology use/integration in the last three years; and 41 respondents (9%) had not participated in professional development in technology use/integration in the last three years,. Twenty-two respondents (5%) did not indicate whether or not they had participated in professional development in technology use/integration in the last three years.

The Kruskal-Wallis test revealed significance between the respondents' rating of the level of use of 21st century technology tools and technology professional development participation in the last three years. Significance was found in five of the 31 areas, Wikis (p=.045), Database Software (p=.048), Web Authoring Software (p=.004), Educational Software (p=.014), and Practice Drills/Tutorials (p=.001). Table 26 presents significance in the respondents' reported level of use between 21st century technology tools and participation in technology professional development indicated by respondents.

Table 26. Significance between Technology Tool Use and Technology Professional Development Participation

Tools	Chi-Square	df	Asymp. Sig
Computer	.024	1	.878
Cell Phone	2.177	1	.140
Classroom Responders	.496	1	.481
Digital Camera	.146	1	.702
GIS System	.382	1	.536
Handheld Computer	.029	1	.864
iPod	2.808	1	.094
Interactive Whiteboard	.670	1	.413
World Wide Web	.093	1	.761
Blog	.304	1	.581
Chat	.459	1	.498
Distance Learning	1.696	1	.193
Email	.821	1	.365
Instant Messaging	.030	1	.862
Podcasts	2.623	1	.105
Virtual Realities	3.004	1	.083
Wikis	4.025	1	*.045
Video Conferencing	.504	1	.478
Database Software	3.923	1	*.048
Desktop Publishing Software	2.030	1	.154
Presentation Software	3.182	1	.074
Spreadsheet Software	.005	1	.945
Web Authoring Software	8.134	1	*.004
Word Processing Software	.959	1	.327
Audio Editing Software	1.049	1	.306
Concept Mapping Software	1.031	1	.310
Draw/Paint Software	2.315	1	.128
Image Editing Software	.275	1	.600
Video Editing Software	.397	1	.529
Educational Software	6.032	1	.014
Practice Drills/Tutorials	12.106	1	*.001

*Significant at the 0.05 level.

Further analysis of mean rank scores (Table 27) revealed that respondents who had participated in technology use/integration professional development in the last three years rated the level of use of 21st century technology tools higher than respondents who had not participated in technology use/integration professional development across all technology tools where significance existed.

Table 27. Mean Rank Scores between Technology Tool Use and Technology Professional Development Participation

Tools	Response	N	Mean Rank
Wikis	No	41	186.55
	Yes	377	212.00
	Total	418	
Database Software	No	40	174.11
	Yes	376	212.16
	Total	416	
Web Authoring Software	No	41	173.01
	Yes	373	211.29
	Total	414	
Educational Software	No	41	166.46
	Yes	378	214.72
	Total	419	
Practice Drills/Tutorials	No	40	143.21
	Yes	365	209.55
	Missing	41	
	Total	405	

The Kruskal-Wallis test also revealed significance between the respondents' ratings of the level of use of 21st century technology tools to create a 21st century context for learning and technology use/integration professional development. Significance was found in one of the 14 areas, Solving Real-World Problems (p=.033). Table 28 presents the levels of significance.

Table 28. Significance between Technology Tool Use to Create 21st Century Context and Technology Professional Development Participation

Context	Chi-Square	df	Asymp. Sig
Data Collection	3.174	1	.075
Solving Real-World Problems	4.521	1	*.033
Analyzing and/or Visualizing Data	0.568	1	.451
Demonstrations/Simulations	3.305	1	.069
Playing Real-World Educational Games	0.200	1	.655
Graphical Presentation of Materials	3.563	1	.059
Producing Multimedia Reports/Projects	1.490	1	.222
Webpage Design	1.722	1	.189
Conducting Research	2.224	1	.136
Taking Students on Virtual Field Trips	2.426	1	.119
Collaboration	1.301	1	.254
Communication	1.333	1	.248
Basic Skill Development/Assessment	1.067	1	.302
Locating Internet/Web Resources	1.068	1	.301

*Significant at the 0.05 level.

Further analysis of mean rank scores (Table 29) revealed that respondents who had participated in technology use/integration professional development in the last three years also rated their level of use of 21st century technology tools to create a 21st century context for learning activities higher than those who had not participated in technology use/integration professional development where significance existed.

Table 29. Mean Rank Scores between Technology Tool Use to Create 21st Century Context and Technology Professional Development Participation

Context	Response	N	Mean Rank
Solving Real-World Problems	No	41	172.59
	Yes	378	214.06
	Total	419	

Completion of Online Courses/Workshops in the Last Three Years

Participants were asked whether or not they had completed an online course or workshop in the last three years. A majority of respondents had not completed an online course or workshop. Of the 446 respondents, 177 (40%) had completed an online course or workshop; and 243 (55%) had not completed an online course or workshop, for a total

of 420 respondents. Twenty-six respondents (6%) did not indicate whether or not they had completed an online course or workshop in the last three years.

The Kruskal-Wallis test revealed significance between the respondents' rating the level of use of 21st century technology tools and completion of online courses or workshops in the last three years. Significance was found in 13 of the 31 areas, Classroom Responders (p=.027), Interactive Whiteboard (p=.004), World Wide Web (p=.000), Blog (p=.000), Chat (p=.021), Distance Learning (p=.000), Podcasts (p=.015), Desktop Publishing Software (p=.028), Presentation Software (p=.001), Audio Editing Software (p=.031), Concept Mapping Software (p=.012), Image Editing Software (p=.030), and Video Editing Software (p=.018). Table 30 presents significance in the respondents' reported level of use between 21st century technology tools and online course or workshop completion in the last three years.

Table 30. Significance between Use of 21st Century Technology Tools and Online Courses/Workshop Completion

Tools	Chi-Square	df	Asymp. Sig
Computer	1.046	1	.306
Cell Phone	.000	1	.983
Classroom Responders	4.859	1	*.027
Digital Camera	.956	1	.328
GIS System	2.328	1	.127
Handheld Computer	.008	1	.929
iPod	3.248	1	.072
Interactive Whiteboard	8.256	1	*.004
World Wide Web	12.339	1	*.000
Blog	16.491	1	*.000
Chat	5.353	1	*.021
Distance Learning	21.339	1	*.000
Email	.000	1	.987
Instant Messaging	1.532	1	.216
Podcasts	5.928	1	*.015
Virtual Realities	2.597	1	.107
Wikis	2.753	1	.097
Video Conferencing	.104	1	.747
Database Software	2.940	1	.086
Desktop Publishing Software	4.857	1	*.028
Presentation Software	11.728	1	*.001
Spreadsheet Software	.704	1	.402
Web Authoring Software	.279	1	.597
Word Processing Software	2.295	1	.130
Audio Editing Software	4.630	1	*.031
Concept Mapping Software	6.345	1	*.012
Draw/Paint Software	2.262	1	.133
Image Editing Software	4.725	1	*.030
Video Editing Software	5.563	1	*.018
Educational Software	2.430	1	.119
Practice Drills/Tutorials	.016	1	.899

*Significant at the 0.05 level.

Further analysis of mean rank scores (Table 31) revealed that respondents who had completed online courses/workshops in the last three years rated their level of use of 21st century technology tools higher than respondents who had not completed online courses/workshops in the last three years for 11 of the 13 technology tools. For handheld computer and email the level of use was greater for those who had not participated in online courses/workshops.

Table 31. Mean Rank Scores between Technology Tool Use and Online Course/Workshop Completion

Tools	Response	N	Mean Rank
Interactive Whiteboard	No	239	193.63
	Yes	173	224.29
	Total	412	
World Wide Web	No	242	191.93
	Yes	175	232.60
	Total	417	
Blog	No	241	196.13
	Yes	175	225.54
	Total	416	
Chat	No	240	200.22
	Yes	172	215.26
	Total	412	
Distance Learning	No	240	190.65
	Yes	175	231.79
	Total	415	
Podcasts	No	238	197.60
	Yes	170	214.16
	Total	408	
Presentation Software	No	239	190.42
	Yes	174	229.77
	Total	413	
Audio Editing Software	No	241	201.76
	Yes	175	217.78
	Total	416	
Concept Mapping Software	No	239	199.42
	Yes	176	219.65
	Total	415	
Image Editing Software	No	239	198.12
	Yes	172	216.94
	Total	411	
Video Editing Software	No	237	199.01
	Yes	175	216.65
	Missing	34	
	Total	412	

The Kruskal-Wallis test also revealed significance between the respondents' ratings of the level of use of 21st century technology tools to create a 21st century context for learning and online course/workshop completion. Significance was found in nine of the 14 areas, Data Collection (p=.010), Solving Real-World Problems (p=.002),

Analyzing and/or Visualizing Data (p=.047), Demonstrations/Simulations (p=.003), Graphical Presentation of Materials (p=.008), Producing Multimedia Reports/Projects (p=.000), Collaboration (p=.008), Communication (p=.000), and Locating Internet/Web Resources (p=.045). Table 32 presents the levels of significance.

Table 32. Significance between Technology Tool Use to Create 21st Century Context and Online Course/Workshop Completion

Context	Chi-Square	df	Asymp. Sig
Data Collection	6.589	1	*.010
Solving Real-World Problems	9.975	1	*.002
Analyzing and/or Visualizing Data	3.953	1	*.047
Demonstrations/Simulations	8.724	1	*.003
Playing Real-World Educational Games	1.085	1	.298
Graphical Presentation of Materials	6.980	1	*.008
Producing Multimedia Reports/Projects	19.894	1	*.000
Webpage Design	3.318	1	.069
Conducting Research	1.996	1	.158
Taking Students on Virtual Field Trips	2.917	1	.088
Collaboration	7.072	1	*.008
Communication	18.227	1	*.000
Basic Skill Development/Assessment	0.149	1	.699
Locating Internet/Web Resources	4.006	1	*.045

*Significant at the 0.05 level.

Further analysis of mean rank scores (Table 33) revealed that respondents who had completed an online course/workshop in the last three years rated their level of use of 21st century technology tools to create a 21st century context for learning higher in all nine areas.

Table 33. Mean Rank Scores between Technology Tool Use to Create 21st Century Context and Online Course/Workshop Completion

Context	Response	N	Mean Rank
Data Collection	No	239	195.76
	Yes	177	225.71
	Total	416	
Solving Real-World Problems	No	239	192.37
	Yes	176	229.23
	Total	415	
Analyzing and/or Visualizing Data	No	237	197.14
	Yes	176	220.28
	Total	413	
Demonstrations/Simulations	No	239	203.53
	Yes	177	215.21
	Total	416	
Graphical Presentation of Materials	No	236	192.56
	Yes	174	223.05
	Total	410	
Producing Multimedia Reports/Projects	No	237	183.98
	Yes	173	234.99
	Total	410	
Collaboration	No	237	194.22
	Yes	174	222.05
	Total	411	
Communication	No	237	187.55
	Yes	172	229.04
	Total	409	
Locating Internet/Web Resources	No	236	192.81
	Yes	68	216.12
	Total	404	

Participation in Technology Related Training/Activities in the Last Three Years

Participants were asked to indicate the training/activities they had participated in during the last three years. Of the 446 respondents, 102 (23%) reported participation in 21st Century Leadership Team training/activities, 77 (17%) reported participation in Marco Polo (Thinkfinity) training/activities, 56 (13%) reported participation in Other technology related training/activities, 50 (11%) reported having received SAS inSchool training, 31(7%) reported Technology Integration Specialist training, 31 (7%) reported participation in Intel training/activities, and 147 (33%) reported having no 21st century

technology training. Eleven participants (3%) did not specify whether or not they had participated in any of the 21st century technology training activities. Table 34 presents the frequency of participation in 21st century technology training.

Table 34. Frequency of Participation in 21st Century Technology Training

Participation in training/activities	Yes Frequency	Percent	No Frequency	Percent
21st Century Leadership Team	102	23%	333	76%
Marco Polo (Thinkfinity)	77	18%	358	82%
Other	56	13%	379	87%
SAS inSchool	50	12%	385	88%
Technology Integration Specialist (TIS)	31	7%	404	93%
Intel	29	7%	406	93%
None	147	34%	288	66%
More than one	81	19%	NA	NA

Percentage of Students in School Receiving Free or Reduced Lunch

Participants were asked to identify the percentage of students receiving free or reduced lunch at their school (below 35%, between 35% and 50%, between 50% and 75%, and above 75%). Of the 446 respondents, 32 (7%) indicated low poverty (<35%), 83 (19%) indicated medium poverty (35-50%), 135 (30%) indicated high poverty (50-75%), 61 (14%) indicated very high poverty (>75%,), and 113 (25%) indicated "not sure," for a total of 424 respondents. Twenty-two respondents (5%) did not indicate the percentage of students that receive free or reduced lunch in their school. The Kruskal-Wallis test revealed significance between the respondents' ratings of the level of use of 21st century technology tools and the percentage of students receiving free or reduced lunch. Significance was found related to one of the 31 technology tools, Handheld Computer (p=.021). Table 35 presents the levels of significance.

Table 35. Significance between Technology Tool Use and Students Receiving Free/Reduced Lunch

Tools	Chi-Square	df	Asymp. Sig
Computer	6.394	4	.172
Cell Phone	4.328	4	.363
Classroom Responders	6.230	4	.183
Digital Camera	3.748	4	.441
GIS System	7.303	4	.121
Handheld Computer	11.565	4	*.021
iPod	4.100	4	.393
Interactive Whiteboard	8.795	4	.066
World Wide Web	1.496	4	.827
Blog	5.716	4	.221
Chat	4.934	4	.294
Distance Learning	6.581	4	.160
Email	3.841	4	.428
Instant Messaging	4.332	4	.363
Podcasts	7.897	4	.095
Virtual Realities	0.779	4	.941
Wikis	8.097	4	.088
Video Conferencing	5.366	4	.252
Database Software	5.851	4	.211
Desktop Publishing Software	1.264	4	.868
Presentation Software	5.845	4	.211
Spreadsheet Software	6.134	4	.189
Web Authoring Software	2.431	4	.657
Word Processing Software	4.580	4	.333
Audio Editing Software	3.989	4	.408
Concept Mapping Software	5.259	4	.262
Draw/Paint Software	0.205	4	.995
Image Editing Software	1.514	4	.824
Video Editing Software	2.623	4	.623
Educational Software	7.085	4	.131
Practice Drills/Tutorials	6.239	4	.182

*Significant at the 0.05 level.

Analysis of mean rank scores was completed to discover the nature of the statistical significance between the percentage of students receiving free or reduced lunch and frequency of use for the one 21st century technology tool. The greater the mean rank score, the greater the level of use of technology tools by the group. Further analysis of mean rank scores (Table 36) based on percentage of students receiving free or reduced lunch and their technology tool use revealed that teachers in schools who reported more than 75% of the students receiving free or reduced lunch (very high poverty schools) use Handheld Computers more than all other groups.

Table 36. Mean Rank Scores between Technology Tool Use and Students Receiving Free/Reduced Lunch

Tools	Percentage Free or Reduced Lunch				
	Below 35%	Between 35%-50%	Between 50%-75%	Above 75%	Not Sure
Handheld Computer	212.98	211.80	222.00	247.67	195.69

The Kruskal-Wallis test also revealed significance between the respondents' ratings of the level of use of 21st century technology tools to create a 21st century context for learning and the percentage of students in school who receive free or reduced lunch. Significance was found in one of the 14 areas, Basic Skill Development/Assessment (p=.010). Table 37 presents the levels of significance.

Table 37. Significance between Technology Tool Use to Create 21st Century Context and Students Receiving Free/Reduced Lunch

Context	Chi-Square	df	Asymp. Sig
Data Collection	1.504	4	.826
Solving Real-World Problems	6.155	4	.188
Analyzing and/or Visualizing Data	7.374	4	.117
Demonstrations/Simulations	1,632	4	,803
Playing Real-World Educational Games	2.407	4	.661
Graphical Presentation of Materials	8.935	4	.063
Producing Multimedia Reports/Projects	4.887	4	.299
Webpage Design	2.324	4	.676
Conducting Research	2.236	4	.692
Taking Students on Virtual Field Trips	1.122	4	.891
Collaboration	5.605	4	.231
Communication	4.947	4	.293
Basic Skill Development/Assessment	13.233	4	.010*
Locating Internet/Web Resources	7.737	4	.102

*Significant at the 0.05 level.

Further analysis of mean rank scores (Table 38) revealed that students/teachers in schools with a high poverty level (more than 75% of students receiving free/reduced lunch) use technology for Basic Skill Development/Assessment more than all other groups.

Table 38. Mean Rank Scores between Technology Tool Use to Create 21st Century Context and Students Receiving Free/Reduced Lunch

Context	Percentage Free Reduced Lunch				
	Below 35%	Between 35%-50%	Between 50%-75%	Above 75%	Not Sure
Basic Skill Development/Assessment	232.52	197.95	213.66	248.31	185.40

Summary

This chapter presented the statistical and qualitative analyses of data collected from the *West Virginia Teachers' Technology Tools and Use Survey*. An in-depth review of the literature revealed the importance of examining how often West Virginia PK-12 teachers integrate 21st century technology tools, how often West Virginia PK-12 teachers use 21st century technology tools to create a 21st century context for learning, and the factors (supports/barriers) influencing their instructional technology practices. The *West Virginia Teachers' Technology Tools and Use Survey* was completed by 446 teachers giving a 59% return rate for a 95% confidence level with a 4.56% margin of error or a 99% confidence level with a 6% margin of error.

The *West Virginia Teachers' Technology Tools and Use Survey* utilized a seven point Likert scale for respondents to rate how often they integrate 21st century technology tools to create a 21st century context for learning. After collection and coding of the data, SPSS 16.0 was used to calculate descriptive statistics. Percentages, frequencies (mode), mean scores, and standard deviations were calculated for ease of interpretation of the survey. Frequencies were calculated for respondents' identification of factors supporting and/or prohibiting technology integration in instruction. In addition, since this research was a non-parametric descriptive study, the Kruskal-Wallis test was used to determine statistical significance based on demographic data provided by the sample population.

Based on analysis of modes, the majority of West Virginia teachers reported "Daily" (7) use of Computers, the World Wide Web, Email, and Word Processing. The majority of respondents reported "Not at All" (1) for the 27 remaining 21st century technology tools. Other measures of central tendency (M) were calculated to account for variability in responses. Mean scores for the level of use of 21st century technology tools ranged from 5.98 ("Several Times a Week") for Computer to 1.13 ("Not at All") for Virtual Reality. On average (M) West Virginia teachers reported integrating Computers and the World Wide Web from "Once a Week" to "Several Times a Week"; Email, Word Processing Software, and Educational Software from "Several Times a Month" to "Once a Week"; Desktop Publishing and Practice Drills/Tutorials from "Once a Month" to "Several Times a Month"; Cell Phone, Digital Camera, Interactive Whiteboard, Database Software, Presentation Software, and Spreadsheet Software from "Less Than Once a Month" to "Once a Month." Average (M) reported use for the remaining 18 tools ranged from "Not at All" to "Less Than Once a Month."

Technology tools were also grouped and analyzed by categories—Hardware Tools, Internet Based Tools, Applications Software Tools, Multimedia Tools, and Other Technology Tools. Cumulative data within each category indicates that the majority (mode) of West Virginia teachers reported "Not at All" (1). Mean scores calculated to account for variability in responses show that on average Other Tools (3.79) are used most often (from "Once a Month" to "Several Times a Month"), followed by Applications Software Tools (2.84), Hardware Tools (2.57), and Internet Based Tools (2.05) used between "Less Than Once a Month" and "Once a Month." Based on these

five categories, Multimedia Tools (1.52) are used least often, from "Not at All" to "Less Than Once a Month."

A summation of mean, mode, and standard deviation scores was calculated across all 31 of the 21st century technology tools. The cumulative mode (1) indicates that the majority of West Virginia teachers selected "Not at All" when asked how often they integrate 21st century technology tools. Further analysis, using mean scores to account for variability in responses, shows that on average (2.36) West Virginia teachers use 21st century technology tools from "Less Than Once a Month" to "Once a Month."

Respondents used a seven point Likert scale to identify how often they use 21st century technology tools in activities designed to create a 21st century context for learning. Percentages, frequencies (modes), mean scores, and standard deviations were calculated for each statement. Based on analysis of modes, the majority of West Virginia teachers reported Locating Internet/Web Resources "Several Times a Month" (4). The majority of respondents reported "Not at All" (1) for the 13 remaining 21st century context items.

Other measures of central tendency (M) were calculated to account for variability in responses. Mean scores for the level of use of 21st century technology tools to create a 21st century context for learning ranged from 4.14 ("Several Times a Month") for Locating Internet/Web Resources to 1.43 ("Not at All") for Webpage Design. On average (M) West Virginia teachers reported engaging students in Data Collection, Solving Real-World Problems, Analyzing and/or Visualizing Data, Conducting Research, and Basic Skill Development/Assessment from "Once a Month" to "Several Times a Month." Demonstrations/Simulations, Playing Educational Real-World Games, Graphical

Presentation of Materials, and Producing Multimedia Reports/Projects were used on average (M) between "Less Than Once a Month" and "Once a Month." Average (M) reported use for Webpage Design, Taking Students on Virtual Field Trips, Collaboration, and Communication ranged from "Not at All" to "Less Than Once a Month."

A summation of mean, mode, and standard deviation scores was calculated across all 14 items related to using technology tools to create a 21st century context for learning. The cumulative mode (1) shows that the majority of West Virginia teachers indicated "Not at All" when asked how often they use 21st century technology tools to create a 21st century context for learning. Further analysis, using a cumulative mean score to account for variability in responses, shows that on average (2.75) West Virginia teachers use 21st century technology tools to create a 21st century context for learning from "Less Than Once a Month" to "Once a Month."

The majority of West Virginia teachers recognized 12 supports for the integration of technology, from a checklist of 26 items prominent in the literature. Supports to using technology in instruction, revealed by 50% or more of respondents, included having a computer at home, Internet access at home, access to Internet in their classroom, access to Internet elsewhere in their school, interest in using technology for classroom instruction, school policy allows access to email, enough computers elsewhere in their school, technology was a priority of the school administration, school policy allows adequate student/teacher use of technology, technical support was available at the school level, technology was a priority of district administration, and support available at the district/regional/state level. Only two of 26 barriers to technology integration were identified by 50% or more of West Virginia teachers, including not enough time to

explore new technology tools and applications and an inadequate number of computers in classrooms.

Checklists of supports and barriers were reinforced by written descriptions and examples. Teachers described the most significant supports and barriers in making them successful and/or preventing them from integrating technology. The greatest diversity was in the area of funding which appeared as both a support and a barrier. Some respondents indicated ample funding was available and that their school was "overflowing with technology," while others simply claimed, "inadequate funding."

Ancillary findings in this study indicated some significance in respondents' ratings of the level of use of 21st century technology tools. Significance was found in rating the level of use when compared to age range, current grade level taught, current subject taught, years experience as a full time teacher, participation in technology use/integration professional development in the last three years, completion of online course/workshop in the last three years, and percentage of students in school receiving free or reduced lunch. Significance was found in rating the level of use of some 21st century technology tools to create a 21st century context for learning when compared to current grade level taught, current subject taught, years experience as a full time teacher, participation in technology use/integration professional development in the last three years, completion of online course/workshop in the last three years, and percentage of students in school receiving free or reduced lunch. There was no significance in rating the level of use of 21st century technology tools to create a 21st century context for learning when compared to age range.

CHAPTER FIVE: SUMMARY AND DISCUSSION

Introduction

Teachers who use computers report using them for planning instruction and locating information for planning lessons rather than for integrating technology into instruction (Becker, 1994; CEO Forum, 2001). In fact, teachers are generally unprepared to meaningfully integrate technology into the curriculum (Cuban, 2001). In educating America's children for a technological world, schools must have the infrastructure in place before technology can be fully integrated into the curriculum. The literature indicates that even when 21st century technology tools are available they are not being used for the kind of teaching and learning that a 21st century context should promote (Becker, 1998; Becker & Ravitz, 1999). In 2006, Technology Counts ranked West Virginia as the top state in the nation for computer access, technology use, and technology capacity in schools. However, in 2007 (Technology Counts) West Virginia's overall grade fell from "A" to "B" because of its capacity to use technology grade of "C."

The U.S. General's Accounting Office (1995), concerned with whether America's schools have appropriate technologies, such as computers, and the facility infrastructure to support these technologies, conducted a national survey of school facilities. They reported that, overall, the nation's schools were not even close to meeting their basic technology needs. Most schools do not fully use modern technology, and not all students have equal access to facilities that can support education in the 21st century, even those attending school in the same district (U.S. General's Accounting Office, 1995). For West Virginia students to "have a strong grasp of 21st century skills and remain competitive in a 21st century global economy," students and teachers must have access to appropriate

technology tools and resources so they can "thrive in the complex life and work environments of the 21st century" (Fadel, as cited by Stansbury, 2007).

This chapter presents the conclusions regarding West Virginia teachers' use of 21st century technology tools, use of 21st century technology tools to create a 21st century context for learning, and the factors that influence their use. Implications and recommendations for further study derived from the findings of the *West Virginia Teachers' Technology Tools and Use Survey* are also presented.

Research Questions

The following research questions were addressed through mixed methods:

1. How often are West Virginia PK-12 teachers integrating 21st century technology tools as defined by the Partnership for 21st Century Skills?
2. How often are West Virginia PK-12 teachers integrating 21st century technology tools to create a 21st century context for learning, as defined by the Partnership for 21st Century Skills?
3. What factors influence West Virginia PK-12 teachers' use of 21st century technology tools to create a 21st century context for learning?

Methods

This mixed methods study used quantitative and qualitative methods to examine West Virginia PK-12 teachers' readiness to implement the Partnership for 21st Century Skills initiative. The researcher-designed survey, *West Virginia Teachers' Technology Tools and Use Survey*, was sent to a random sample of West Virginia PK-12 teachers. See Appendix H for the return rate graph.

On the survey, both quantitative and qualitative data were collected. In order to determine how often West Virginia PK-12 teachers integrate 21st century technology tools and how often West Virginia PK-12 teachers integrate 21st century technology tools to create a 21st century context for learning, teachers were asked to rate the level of use of each statement based on a 7-point Likert scale, with 1 = "Not at All," 2 = "Less Than Once a Month," 3 = "Once a Month," 4 = "Several Times a Month," 5 = "Once a Week," 6 = "Several Times a Week," and 7 = "Daily." An open response item designed to gather additional evidence of teaching in a 21st century context was also included. Yes - no items were included to answer research question three, identifying factors that influence teachers' use of 21st century technology tools. An open-response item, designed to provide respondents the opportunity to indicate support mechanisms and barriers that occur while using 21st century technology tools to create a 21st century context for learning, was also included. Finally, demographic data were collected, including: age range, current grade level(s) taught, current subject(s) taught, years experience as a full time teacher, participation in technology use/integration professional development, online course/workshop completion, participation in WVDE sponsored 21st century initiatives, and school's socioeconomic status.

The data were analyzed using SPSS 16.0. Frequencies, means, modes, and standard deviations were calculated for items pertaining to teachers' use of 21st century technology tools and the use of 21st century technology tools to create a 21st century context for learning. Frequencies were calculated for each item pertaining to supports/barriers to the use of 21st century technology tools.

The Kruskal-Wallis test was used to determine if any significance existed between teachers' level of use of each technology tool and demographic data, as well as to determine any significance between teachers' level of use of each 21st century technology tool to create a 21st century context for learning and each category of demographic data. A p value of .05 was used to determine significance for this study.

The qualitative data were collected through open response survey items. The data were coded and analyzed for emergent themes and conceptual categories. Findings were reported using cross-case analysis.

Demographics

The population of the study consisted of 19,713 West Virginia PK-12 teachers. A sample size of 752 was randomly selected to get a 50% plus one return rate of 377 for a 95% confidence level with a 5% margin of error. The random sample was selected from the West Virginia Department of Education database of 2007-08 PK-12 full time teachers. Of the 752 participants asked to complete the *West Virginia Teachers' Technology Tools and Use Survey*, 446 returned the survey representing a 59.3% return rate on multiple emails and mailings for a 95% confidence level with a 4.56% margin of error or a 99% confidence level with a 6% margin of error.

Summary of Findings

In response to the use of 21st century technology tools the majority of West Virginia teachers reported "Daily" use for Computer, World Wide Web, Word Processing Software, and Email. The majority of teachers reported "Not at All" use for the 27 other 21st century technology tools. In response to integrating 21st century technology tools to create a 21st century context for learning, the majority of West

Virginia teachers reported "Several Times a Month" use of Locating Internet/Web Resources. The majority of teachers reported "Not at All" use for the 13 other 21st century context items.

When asked to identify factors that support or prohibit teachers' use of 21st century technology tools to create a 21st century context for learning, 12 of 26 factors were identified as supports and two of 26 factors were identified as barriers by 50% or more of respondents. The top 12 factors that support the use of technology in instruction were: computer at home, Internet access at home, Internet access in the classroom, Internet access elsewhere in the school, interest in using technology for classroom instruction, school policy that allowed email access, adequate number of computers in the school, technology is a priority of school administration, school policy allowed adequate student/teacher use of technology, school level technical support available, technology is a priority of district administration, and technical support available at district/state/regional level. Barriers that prohibit the use of technology in instruction were not enough time to explore new technology tools and applications and inadequate number of computers in the classroom. Although less than half (40%) identified lack of ample funding designated for technology as a barrier, funding issues were frequently mentioned in qualitative responses.

Ancillary findings in this study indicated some significance in respondents' ratings of the level of use of 21st century technology tools. Significance was found in rating the level of use when compared to age range, current grade level taught, current subject taught, years experience as a full time teacher, participation in technology use/integration professional development in the last three years, completion of online

course/workshop in the last three years, and percentage of students in school receiving free or reduced lunch. Significance was found in rating the level of use of some 21st century technology tools to create a 21st century context for learning when compared to current grade level taught, current subject taught, years experience as a full time teacher, participation in technology use/integration professional development in the last three years, completion of online course/workshop in the last three years, and percentage of students in school receiving free or reduced lunch. There was no significance in rating the level of use of 21st century technology tools to create a 21st century context for learning when compared to age range.

Findings Related to the Literature

Analyses of the data collected in this study provided multiple connections to the literature involving teachers' use of 21st century technology tools, teachers' use of 21st century technology tools to create a 21st century context for learning, and the factors that influence their use. Major findings related to the literature are categorized by: 21st century technology tools, 21st century context, and supports and barriers.

21st Century Technology Tools

The results of this study provide a clear picture of West Virginia PK-12 teachers' readiness to implement the Partnership for 21st Century Skills initiative by using 21st century technology tools and creating a 21st century context for learning. In looking at how teachers use 21st century technology tools this study found 96% use computers, with 53% indicating "Daily" use. Ninety-one percent (91%) use World Wide Web with 37% indicating "Daily" use. Seventy-nine percent (79%) use Word Processing software with

21% indicating "Daily" use. Sixty-five percent (65%) use Email with 38% indicating "Daily" use.

To make a comparison with other research, these findings mirror results of a study by Becker and Riel (2000) that revealed that software applications more likely to be used by teachers knowledgeable in the use of computers included presentation software, World Wide Web browsers, electronic mail, spreadsheets and database software, and multimedia authoring software in English, social studies and elementary classes. In looking at the same software applications used by West Virginia teachers, this study found 91% use World Wide Web with 37% indicating "Daily" use. Sixty-five percent (65%) use Email with 38% indicating "Daily" use. Sixty percent (60%) use Presentation Software with 18% indicating "Less Than Once a Month" use. Fifty percent (50%) use Spreadsheet Software with 18% indicating "Less Than Once a Month" use. Multimedia Tools (Audio Editing Software, Concept Mapping Software, Draw/Paint Software , Image Editing Software, and Video Editing Software) were most often reported as being used "Not at All."

Cuban (2001) concluded that in spite of the apparent commitment to technology in some schools, it appears that many teachers only use computers to support their current traditional teaching practices rather than as a tool to promote more innovative, constructivist practices. Although there were several years between both the Becker and Riel study and Cuban's work and this West Virginia study, the findings were essentially the same. While the trend indicates an increase in usage, teachers are still mainly using computers for Word Processing, to Locate Internet/Web Resources, and to communicate via Email. Use of the latest 21st century technology tools is less frequent.

Research conducted by Murphy and Lacy (2007) revealed that transformation in current education practices is effective enough to infiltrate the educational process with technology integration. They noted that the chalkboard, a thing of the past, has been replaced with an interactive whiteboard that projects animated images which can be manipulated with the touch of the hand and written on with a digital pen. This West Virginia study found the majority of teachers rated the level of use of Interactive Whiteboard from "Less Than Once a Month" to "Once a Month." Teachers who reported they used an interactive whiteboard described activities such as "daily use to complete reading assignments" or "taking a virtual tour of a 1906 California earthquake."

Becker's (2000) research concluded that the best educational practices would be the defining and then refining of various methods of teaching with technology promoting meaningful learning for students. West Virginia State Board Policy has mandated the development of 21st Century Learning Skills and Technology Tools Content Standards and Objectives for West Virginia Schools that will be effective in July 2008. The Strategic Work Plan and the Comprehensive Report of Findings are intended for providing a 21st century education and identifying the skills essential for PK-12 students in West Virginia "for future success in the workplace and further education" (West Virginia Board of Education, 2007, Section 4). The newly refined methods of teaching with technology include using a handheld remote to respond to questions. In West Virginia, the majority of teachers reported their level of use as "Not at All" for Classroom Responders (69%). The majority of teachers also reported their level of use as "Not at All" for Handheld Computer (69%), GPS (85%) and iPod (73%), some of the devices most recently adapted for classroom instruction.

For many students the impact of technology on everyday life is no surprise. They connect with their friends via e-mail, instant messaging, and chat rooms online; search the Web to explore their interests; express themselves fluently using new media; learn with educational software; play video and computer games in virtual realities; manipulate digital photos; go behind the scenes on DVDs; channel surf on television; and chat on and take photographs with cell phones. Through these media, they identify with their peers in the global culture through music, games, toys, fashion, animation, and movies (Hartwell, 1996). This West Virginia study found that for the majority of teachers use of 21st century technology tools varied. "Not at All" use of World Wide Web (8%), Educational Software (20%), Email (34%), Digital Camera (38%), Cell Phone (63%) Instant Messaging (79%), Wikis (83%), Blogs (85%), Podcasts (85%), Chat (87%), and Virtual Realities (92%), reveals that West Virginia teachers rarely use technology in the classroom in ways that relate to technology used in their students' daily lives. This use of 21st century technology tools to make education relevant to the world around us has the potential to make everything around us simpler, and easier and better to use or operate (Partnership for 21st Century Skills, 2006).

21st Century Context

From being one of the most sought after systems of the 20th century, the education system of today has been at the stage of irrelevancy and might fail one day from being the actual growth engine of the United States of America. Modern age students are expected to be equipped with 21st century skills so they can effectively research, conceptualize, organize and present ideas, and debate current affairs, skills that will make them a link between the top management and the work force at the entry level

(Partnership for 21st Century Skills, 2006). West Virginia teachers' readiness to equip students with 21st century skills ranges from using Webpage Design (19%) projects for organizing and presenting ideas to Locating Internet Web Resources (81%).

At the conclusion of the ten year long "Apple Classroom of Tomorrow" (ACOT) project, which set out to investigate how technology use by teachers and students would affect teaching and learning, Sandholtz, Ringstaff, and Dwyer (1997) offered guiding principles to teachers and schools. One of the "core principles" from their study is that "technology is most powerfully used as a new tool to support student inquiry, composition, collaboration, and communication" (p. 183). They also concluded that, "To those [educators] looking for a powerful tool to support collaborative learning environments, technology holds tremendous potential" (p. 184). In brief "technology in and of itself will not change education; what matters is how it is used" (p. 10). West Virginia teachers are barely tapping into the potential of using technology in ways that frequently engage students in Collaboration (57%) and Communication (65%), as evidenced by the majority of West Virginia teachers who answered "Not at All."

Newman, Bryk, and Nagaoka (2001) found that students learn more when they are engaged in meaningful, relevant, and intellectually stimulating work. Eighty-one percent (81%) of West Virginia teachers reported some level of use of Locating Internet/Web Resources to create a 21st century context for learning. While learning is deeply personal, the frequency and relevance of such moments increase when technology enables teachers and students to tap outside experts; visualize and analyze data; link to real-world contexts; and take advantage of opportunities for feedback, reflection, and analysis (Bransford, et al., 1999). West Virginia teachers reported extremely low use of

Wikis (83%), Blogs (85%), and Podcasting (85%), with the majority indicating "Not at All" use. Research by The Partnership indicated that students should be using Web 2.0 tools to engage in regular collaboration, where they access and "remix" digital information, and extend their learning beyond the traditional school day. West Virginia teachers rarely provide students opportunities to extend their learning beyond the classroom by continuing to use instructional strategies that are outdated, lack technology integration, and are irrelevant to the world in which their students live. "Students who have access to technology outside of school will find schools without access to and integration of technology into their coursework to be antiquated and irrelevant to their world" (Partnership for 21st Century Skills, 2002, p.7).

Respondents in this study revealed that they engaged students, at some level, in Solving Real-World Problems (68%), Analyzing and/or Visualizing Data (67%), Conducting Research (65%), Graphical Presentation of Materials (63%), and Producing Multimedia Reports/Projects (60%), activities that are designed to create a 21st century context for learning. West Virginia teachers engage students to some extent in Communication (30%), Collaboration (38%), and Webpage Design (19%), verifying that using technology to create a 21st century context is often neglected in these areas. The majority of West Virginia teachers indicated "Not at All" use when considering all other responses. Across subject areas significance existed in the respondent's level of use of 21st century tools to create a 21st century context for learning. Data Collection, Solving Real-World Problems, and Analyzing and/or Visualizing Data were used by Math teachers more than others; Social Studies teachers reported using Graphical Presentation of Materials and Producing Multimedia Reports more than others; Playing Educational

Real-World Games and Locating Internet/Web Resources were used by Special Education teachers more; and teachers in Self-contained classes used Basic Skill Development/Assessment activities more than others. However teachers in other subject areas are not maximizing the use of appropriate tools to create a 21st century context for learning. This West Virginia study aligns with research conducted by Barron, Kemker, Harmes, and Kalaydjian (2003) that concluded many teachers are implementing technology as a tool for research, communication, productivity, and problem solving; however, the goal of technology integration across all subject areas and grade levels has not yet been reached.

According to Linden Research (2007), Second Life enhances experiential learning, allows an individual to practice skills, try new ideas, and learn from their mistakes, in fact it has unlimited potential. Yet, only 7% of West Virginia teachers report some level of use of Virtual Realities and 40% reported "Not at All" use of Demonstrations/Simulations, limiting experiential learning opportunities where their students can practice new skills, try out new ideas, reflect on their experiences, and learn from the mistakes they make as they might in the world of work.

By primarily engaging students in activities that involve Locating Internet/Web Resources, West Virginia teachers are limiting students' opportunities to engage in authentic learning experiences. The challenge for educators is to create a context for learning which is congruent with the content and the reinforcement of educational goals that will "enhance cognitive presence and the realization of higher-order learning outcomes" (Anderson, 2003, p. 4). By making content relevant to students' lives, bringing the world into the classroom, and taking students out into the world,

opportunities arise for students to interact with others in authentic learning experiences. West Virginia teachers are missing the opportunity to develop authentic learning experiences that would help students make connections between the work they do in school and their world outside the classroom.

West Virginia teachers reported some level of use of Conducting Research (65%), Graphical Presentation of Ideas (63%), and Producing Multimedia Reports/Projects (60%), with the majority reporting "Not at All."

> To thrive in the world today, students need higher end skills, such as ability to communicate effectively beyond their peer groups, analyze complex information from multiple sources, write or present well-reasoned arguments about nuanced issues and develop solutions to interdisciplinary problems that have no one right answer. (The Policy Guide to 21st Century Skills, 2005, p. 4)

Supports and Barriers

The majority (88%) of West Virginia teachers indicated they had participated in technology use/integration professional development in the last three years. Only 36% reported that the professional development they had participated in was adequate, 23% reported that the professional development related to content specific technology integration was adequate, 30% reported that incentives were available to attend technology training, and 16% reported that follow-up to support the integration of technology was adequate. Fifty-seven percent (57%) of the respondents reported that technical support was available at the school level while 50% reported technical support available at the district/state/regional level. Although 34% of the respondents reported

adequate access to computers in their classroom and 69% reported adequate access to computers elsewhere in their school, 40% of the teachers responded that ample funding was not designated for technology, only 37% reported adequate technology available for integration, and 64% indicated there was not enough time to explore new technology tools and applications. Similar studies also listed lack of time as a major barrier. In order for teachers to possess the technology-related skills needed to use technology, Dawson and Rakes (2003) found that teachers need appropriate research-based training, opportunities to practice skills, access to technology tools, and support from school administrators. Fuller (2000) concluded that technical support was essential if teachers were to use technology in the classroom. He explained that if teachers are not provided the support needed to integrate computers into the overall framework of the classroom, it is unlikely that their students will use computers in ways that will improve their learning process. The research confirms the importance of using technology to develop critical thinking skills, skills necessary for students to compete in the 21st century workforce (Griffin & Kaleba, 2006). Skills like creativity, problem solving, communication, and analytical thinking are necessary for all levels of success, from entry-level jobs to engineering and technical fields (Partnership for 21st Century Skills, 2006).

Numerous studies (Bailey & Pownell, 1998; Guerrero, Walker, & Dugdale, 2004; Judge, Puckett, & Cabuk, 2004; Parr, 1999; Quin Li, 2007) indicate that teachers often list lack of time for learning and integrating as well as the lack of technical and administrative support as barriers to technology integration. Respondents participating in this West Virginia study concurred with participants in national research who also listed a lack of time, a lack of access to hardware and software, and a lack of technical support as

some of the major barriers to the use of 21st century technology in instruction. A positive note from this study is that several participants who indicated they have a computer at home and Internet access at home and Internet access either in their classroom or elsewhere in their school revealed these supports as critical to their success in using technology in instruction. Additionally, 72% of respondents to the survey indicated a major support to be their own interest in using technology for classroom instruction. Prensky (2001), who coined the term digital native to refer to today's students, declares that "we can no longer use either our 20th century knowledge or our training as a guide to what is best for them educationally" (¶ 3). It is critical to exhibit an interest in integrating technology in education since the business world has necessitated technology integration into the classroom, therefore integration has become one of the most critical and challenging tasks for administrators and teachers (Brooks-Young, 2000; Hall, 2000).

Implications for Action

Results of this study provide valuable information to guide decision making by West Virginia policymakers, the West Virginia Department of Education 21st Century Skills initiative, curriculum specialists, administrators, designers of professional development, higher education institutions, as well as state, county, and local school districts. The number of respondents that use 21st century technology tools at a low level shows a need for professional development that focuses on strategies for integrating the use of 21st century technology tools into the curriculum. The low use of 21st century technology tools to create a 21st century context for learning shows a need for more professional development opportunities that focus on strategies for engaging students in activities designed to achieve 21st century teaching and learning skills.

Several *West Virginia Teachers' Technology Tools and Use Surveys* were returned with comments that indicated they worked with kindergarten students who were too young to use technology. Students/teachers in grades PK-2 use technology tools to create a 21st century context for learning less than others in seven areas. This shows that there is a need for professional development for technology integration made available to teachers at all grade levels using multiple strategies and a variety of delivery modes.

This study of West Virginia teachers showed a significant difference in rating the level of use of 21st century technology tools if the teacher participated in technology use/integration. Having participated resulted in both a higher level of use of 21st century technology tools and a higher level of use of 21st century technology tools to create a 21st century context for learning.

Respondents who had completed online courses or workshops rated the level of use of 21st century technology tools higher than those who had not completed online courses or workshops. Respondents who had completed online courses or workshops rated the level of use of 21st century technology tools to create a 21st century context for learning higher than those who had not completed online courses or workshops. Therefore, online professional development should be designed to: 1) provide time to explore new technology tools and applications, 2) provide follow-up support to technology integration, and 3) address content specific technology. Higher education institutions in West Virginia have demonstrated expertise in creation of online courses and could take the lead in the development of a solution that would model examples of research based technology integration and increase teachers' use of 21st century

technology tools and teachers' use of 21st century technology tools to create a 21st century context for learning.

Respondents indicated the major barriers that prevent them from being successful in the integration of technology in instruction included not enough time to explore new technology tools and applications and inadequate number of computers in the classroom. Technology plans need to be revised to provide more up-to-date technology in all classrooms, methods to secure funding for technology, and time for teachers to explore new technology tools and applications.

The low use of 21st century technology tools and of 21st century technology tools to create a 21st century context for learning and the increase in support for teachers' integration of technology signals a lack of readiness of West Virginia teachers' to implement the Partnership for 21st Century Skills initiative. The high interest in using technology for instruction and lack of significant barriers to technology integration signals a willingness to improve practice and accept the challenging demands of using 21st century technology tools to create a 21st century context for learning. Therefore stakeholders can use the following recommendations to prepare teachers to implement the Partnership for 21st Century Skills initiative:

1. Find ways to provide adequate time for teachers to explore new technology tools and applications.
2. Develop guidelines for expenditures of technology funding to ensure adequate access to computers and 21st century technology tools in all classrooms.

3. Develop guidelines for expenditures of technology funding for appropriate technology professional development designed for use of 21st century technology tools.
4. Develop guidelines for expenditures of technology funding for appropriate technology professional development designed for use of 21st century technology tools to create a 21st century context for learning.
5. Design professional development to address research-based content specific technology professional development. Provide incentives and adequate follow-up support.
6. Provide resources for higher education to create online professional development in technology integration. Development of online courses in technology integration could promote shared vision in schools by encouraging participation of the entire staff including teachers, support personnel, and administrators.

Recommendations for Further Research

This study provided some insight into West Virginia teachers' readiness to implement the Partnership for 21st Century Skills initiative. The study revealed teachers' level of use of 21st century technology tools, level of use of 21st century technology tools to create a 21st century context for learning, and the factors that influence their use. The study also raises questions that can only be answered by further research. Recommendations for further research include:

1. The West Virginia Department of Education is currently developing the Teach 21 Website, a website designed to assist colleagues in planning and delivering

effective 21st century instruction. A study of the impact of use of Teach 21 and related state resources over time is recommended.

2. Participants who had participated in technology related professional development used 21st century technology tools more and used 21st century technology tools to create a 21st century context for learning more than the participants who had not. Therefore further study of the impact of various long-term technology professional development is recommended.
3. Participants who had completed online professional development workshops/courses used 21st century technology tools more and used 21st century technology tools to create a 21st century context for learning more than those who had not completed online professional development workshops/courses. Therefore, further study into the impact of online courses and workshops on technology integration would add to the knowledge base on what affects use of 21st century technology tools and use of 21st century technology tools to create a 21st century context for learning.
4. Even though the majority of West Virginia teachers had not completed an online course or professional development, it would be beneficial to conduct a more focused qualitative study to find out what attracts those who complete online coursework or professional development and to determine whether those who had completed an online course or professional development were implementing technology integration strategies in their classrooms. This would enable stakeholders to encourage or mandate online professional development to save time and money.

5. Repeating this study after 2-3 years of implementation of the 21st Century Skills initiative and use of newly revised CSOs could be valuable to see what kind of progress is being made would provide guidance for revisions to school district technology plans.
6. PK-2 teachers use technology tools to create a 21st century context for learning less than others in seven areas. A more focused qualitative study designed to take a closer look at how PK-2 teachers use technology would provide guidance to higher education institutions in developing programs of study.
7. Further study of the 61+ age group who was using several technologies more than others would determine if results were coincidental because of the low N.

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APPENDICES

Appendix A: West Virginia Teachers' Technology Tools and Use Survey

West Virginia Teachers' Technology Tools and Use Survey

1. For INSTRUCTIONAL PURPOSES, how often do you or your students use the following technology tools?	Not at all	Less than once a month	Once a month	Several times a month	Once a week	Several times a week	Daily
Computer	1	2	3	4	5	6	7
Cell Phone	1	2	3	4	5	6	7
Classroom Responders	1	2	3	4	5	6	7
Digital Camera	1	2	3	4	5	6	7
GIS System (GPS, etc.)	1	2	3	4	5	6	7
Handheld Computer (PDA, etc.)	1	2	3	4	5	6	7
iPod (other mp3 device)	1	2	3	4	5	6	7
Interactive Whiteboard	1	2	3	4	5	6	7
World Wide Web	1	2	3	4	5	6	7
Blog	1	2	3	4	5	6	7
Chat	1	2	3	4	5	6	7
Distance Learning (WV Virtual School, WebCT, etc.)	1	2	3	4	5	6	7
Email	1	2	3	4	5	6	7
Instant Messaging	1	2	3	4	5	6	7
Podcasts	1	2	3	4	5	6	7
Virtual Realities (Second Life, etc.)	1	2	3	4	5	6	7
Wikis	1	2	3	4	5	6	7
Video Conferencing	1	2	3	4	5	6	7
Database Software	1	2	3	4	5	6	7
Desktop Publishing Software	1	2	3	4	5	6	7
Presentation Software	1	2	3	4	5	6	7
Spreadsheet Software	1	2	3	4	5	6	7
Web Authoring Software	1	2	3	4	5	6	7
Word Processing Software	1	2	3	4	5	6	7
Audio Editing Software	1	2	3	4	5	6	7
Concept Mapping Software	1	2	3	4	5	6	7
Draw/Paint Software	1	2	3	4	5	6	7
Image Editing Software	1	2	3	4	5	6	7
Video Editing Software	1	2	3	4	5	6	7
Educational Software	1	2	3	4	5	6	7
Practice Drills/Tutorials	1	2	3	4	5	6	7
Other (please list)							

2. For INSTRUCTIONAL PURPOSES, how often do you or your students USE TECHNOLOGY for the following types of activities?	Not at all	Less than once a month	Once a month	Several times a month	Once a week	Several times a week	Daily
Data Collection (calculator, CBL, CBR, GIS, handheld computer, probes, spreadsheet, etc.)	1	2	3	4	5	6	7
Solving Real-World Problems (calculator, CBL, CBR, GIS, Google Apps, handheld computer, multimedia, probes, simulation, spreadsheet, videos, etc.)	1	2	3	4	5	6	7
Analyzing and/or Visualizing Data (calculator, CBL, CBR, GIS, Google Apps, handheld computer, simulation, spreadsheet, World Wide Web, etc.)	1	2	3	4	5	6	7
Demonstrations/Simulations (dissections, interactions in virtual workplace, videos that connect learning to real world, etc.)	1	2	3	4	5	6	7
Playing Educational Real-World Games (A.D.A.M., Adventures of Jasper Woodbury, Carmen Sandiego Series, ClueFinders, Mavis Beacon Teaches Typing, Oregon Trail, Reader Rabbit, Zoombini, etc.)	1	2	3	4	5	6	7

Graphical Presentation of Materials (AutoCAD, Google Apps, Hyperstudio, PowerPoint, Print Shop, etc.)	1	2	3	4	5	6	7
Producing Multimedia Reports/Projects (PowerPoint, podcasts, videos, etc.)	1	2	3	4	5	6	7
Webpage Design (FrontPage, Dreamweaver, etc.)	1	2	3	4	5	6	7
Conducting Research (CD-ROM, Internet, online database)	1	2	3	4	5	6	7
Taking Students on Virtual Field Trips/Virtual Tours	1	2	3	4	5	6	7
Collaboration (correspond with experts, authors, students from other schools, etc.)	1	2	3	4	5	6	7
Communication (online chats, online threaded discussions, online whiteboards, instant messaging, wikis, blogs, podcasts)	1	2	3	4	5	6	7
Basic Skill Development/Assessment (CompassLearning, Cornerstone, SkillsBank, CD-Rom games, Internet games, Accelerated Reader, Accelerated Math, etc.)	1	2	3	4	5	6	7
Locating Internet/Web Resources	1	2	3	4	5	6	7
Other (describe)							

3. *Briefly describe a technology related assignment that you frequently ask your students to complete.*

4. *SUPPORTS that help me use technology in my instruction are (check all that apply):*

- ☐ adequate number of computers in my classroom
- ☐ adequate number of computers elsewhere in my school (computer lab, library/media center)
- ☐ adequate technology is available for integration (calculators, scientific probes, handheld computers, etc.)
- ☐ access to Internet in my classroom
- ☐ access to Internet elsewhere in my school (computer lab, library/media center)
- ☐ technology in my school is up-to-date
- ☐ I have a computer at home
- ☐ I have Internet at home
- ☐ I am interested in using technology for classroom instruction
- ☐ I have enough time to explore new technology tools and applications
- ☐ technology supports my curriculum and does not create extra work/effort on my part
- ☐ school policy allows access to e-mail
- ☐ school policy allows access to communicate via blogs, wikis, and other social networking tools
- ☐ school policy allows for adequate student/teacher use of technology
- ☐ network storage capability exists at school
- ☐ technology is a priority of school administration
- ☐ technology is a priority of district administration
- ☐ technology is a priority of school community
- ☐ ample funding is designated for technology
- ☐ ample funding is designated for technology related professional development
- ☐ adequate professional development in technology usage
- ☐ adequate professional development related to content specific technology integration
- ☐ adequate follow-up to support technology integration
- ☐ incentives are provided for participating in technology training
- ☐ technical support available at school level
- ☐ technical support available at district/regional/state level
- ☐ other (describe)

5. *BARRIERS that prevent me from using technology in my instruction are (check all that apply):*

- ☐ inadequate number of computers in my classroom
- ☐ inadequate number of computers elsewhere in my school (computer lab, library/media center)
- ☐ inadequate technology is available for integration (calculators, scientific probes, handheld computers, etc.)
- ☐ no access to Internet in my classroom
- ☐ school policy does not allow for adequate student/teacher use of technology
- ☐ network storage capability does not exist at school
- ☐ technology is not a priority of school administration
- ☐ technology is not a priority of district administration
- ☐ technology is not a priority of school community

☐ no access to Internet elsewhere in my school (computer lab, library/media center) ☐ technology in my school is outdated ☐ I do not have a computer at home ☐ I do not have Internet at home ☐ I am not interested in using technology for classroom instruction ☐ I do not have enough time to explore new technology tools and applications ☐ technology does not support my curriculum and creates extra work/effort on my part ☐ school policy does not allow access to e-mail ☐ school policy does not allow access to communicate via blogs, wikis, and other social networking tools	☐ ample funding is not designated for technology ☐ ample funding is not designated for technology related professional development ☐ inadequate professional development in technology usage ☐ inadequate professional development related to content specific technology integration ☐ inadequate follow-up to support technology integration ☐ incentives are not provided for participating in technology training ☐ technical support is not available at school level ☐ technical support is not available at district/regional/state level ☐ other (describe)_____

6. *Looking back at the supports and barriers, briefly describe the one that is most significant in making you successful and/or preventing you from integrating technology.*

7. *Please complete the following:*

Age	☐ 20-30	☐ 31-40	☐ 41-50	
	☐ 51-60	☐ 61+		
Current Grade Level(s) (check all that apply)	☐ PK	☐ K	☐ 1	☐ 2
	☐ 3	☐ 4	☐ 5	☐ 6
	☐ 7	☐ 8	☐ 9	☐ 10
	☐ 11	☐ 12		
Current Subject(s) (check all that apply)	☐ Self-contained	☐ English/Lang. arts	☐ Math	☐ Science
	☐ Social Studies	☐ Foreign Language	☐ Fine Arts	☐ PE/Health
	☐ Special Education	☐ Other		
How many years have you been employed as a full time teacher? (include this year)				
	☐ 0-5	☐ 6-10	☐ 11-15	☐ 16-20
	☐ 21-25	☐ 26-30	☐ 31-35	☐ 36+
Have you participated in professional development in technology use/integration in the last 3 years?				
	☐ Yes	☐ No		
Have you completed any online courses/workshops in the last 3 years?				
	☐ Yes	☐ No		
Have you participated in any of the following training/activities during the last 3 years?				
(check all that apply)	☐ 21st Century Leadership Team	☐ SAS inSchool	☐ Marco Polo (Thinkfinity)	☐ Intel
	☐ Technology Integration Specialist (TIS)	☐ Other_____	☐ None	
What percentage of students in your school receives free or reduced lunch?				
	☐ below 35%	☐ between 35-50%	☐ between 50-75%	☐ above 75%
	☐ not sure			

Thank you for completing this survey!
If you have lost or misplaced the return envelope, please mail to:

Deborah Clark
Route 1 Box 320
Hinton, WV 25951

Appendix B: Panel of Experts

1. Dr. Cheryl Belcher, Coordinator School and School System Improvement, West Virginia Department of Education, Charleston, WV
2. Dr. Dixie Billheimer, Program Coordinator School Improvement, West Virginia Center for Professional Development, Charleston, WV
3. Donna Landin, e-Learning Coordinator, School and School System Improvement, West Virginia Department of Education, Charleston, WV
4. Dr. Karen Larry, Executive Assistant to the State Superintendent, West Virginia Department of Education, Charleston, WV
5. Richard Lawrence, Executive Director School Improvement, West Virginia Department of Education, Charleston, WV
6. Dr. Sandra Orr, Associate Professor, Department of Education, West Virginia State University, Institute, WV
7. Dr. John Ross, Senior R&D Specialist, Edvantia, Inc., Charleston, WV
8. Kimberly Sigman, Curriculum Specialist, Putnam County Schools, Winfield, WV

Appendix C: Content Validity Questions

1. Will the words be uniformly understood?
2. Do the questions contain abbreviations or unconventional phrases?
3. Are the questions too vague?
4. Is the question too precise?
5. Is the question biased?
6. Is the question objectionable?
7. Is the question too demanding?
8. Is it a double question?
9. Does the question have a double negative?
10. Are the answer choices mutually exclusive?
11. Has the researcher assumed too much knowledge?
12. Has too much been assumed about respondent behavior?
13. Is the question technically accurate?

(Dillman, 2007, pp. 32-78).

Appendix D: Marshall University Institutional Review Board Approval

MARSHALL UNIVERSITY
www.marshall.edu

Office of Research Integrity
Institutional Review Board

Friday, March 14, 2008

Lisa A. Heaton, Ph.D.
Education and Professional Development
100 Angus E. Peyton Dr.
South Charleston, WV. 25303

RE: IRB Study # EX08-0104 **At:** Marshall IRB 2

Dear Dr. Heaton:

Protocol Title:
West Virginia Teachers' Technology Tools and Use Survey

Expiration Date:	3/13/2009	
Our Internal #:	4582	
Type of Change:	(Other)	Exempted
Expedited ?:	☐	
Date of Change:	3/14/2008	
Date Received:	3/14/2008	
On Meeting Date:		
Description:	In accordance with 45CFR46.101(b)(2), the above study and informed consent were granted Exempted approval today by the Marshall University IRB#2 Chair for the period of 12 months. The approval will expire 3/13/09. A continuing review request for this study must be submitted no later than 30 days prior to the expiration date. This study is for student Deborah Clark. The purpose of this anonymous survey study is to: (1) Determine how often WV PK-12 teachers are integrating 21st century technology tools as defined by the Partnership for 21st Century Skills; (2) Determine how often WV PK-12 teachers are integrating 21st century technology tools to create a 21st century context for learning, as defined by the Partnership for 21st Century Skills; (3) Determine what factors influence WV PK-12 teachers' use of 21st century technology tools to create a 21st century context for learning.	

Respectfully yours,

Stephen D. Cooper, Ph.D.
Marshall University IRB #2 Chairperson

Appendix D: Contents of Notification Letter and Initial Email Message

Email Subject: ***West Virginia Teachers' Technology Tools and Use Survey Request***

Greetings:

My name is Deborah Clark, and I am currently a doctoral student at Marshall University Graduate College. I am writing to ask your help in a study of West Virginia teachers being conducted as part of the requirements for completing my doctorate. Your opinions will be very important to the success of the study.

It is my understanding that you are currently a full-time PK-12 West Virginia teacher. You were selected randomly from a list of teachers provided by the West Virginia Department of Education. You are being asked to complete a survey regarding your use of 21st century technology tools and factors that influence your ability to integrate technology into instruction.

Your answers are completely confidential. Data will be reported in aggregate form only with no identification of individuals. The identifying PIN number you are asked to fill in on the survey will only be used as a method to send follow-up surveys to nonresponders. When you return your completed survey, your name will be deleted from the mailing list. Your name is not connected to your answers in any way. This survey is completely voluntary and you may decline to participate without penalty. If you have any questions concerning your rights as a research participant you may contact the Marshall University Office of Research Integrity at (304) 696-7320.

Results from the survey will be used to help make decisions about technology and professional development needs. If you would like to receive a summary of results, please send a message indicating your interest to deborahdclark@suddenlink.net . If you have questions, you may also contact me at 304-466-3982.

Please answer all questions as honestly and accurately as possible. Please complete the online survey by **DATE.** This survey will take approximately 20 minutes to complete. Go to the following website to complete the *West Virginia Teachers' Technology Tools and Use Survey:*

http://www.surveymonkey.com/s.aspx?sm=f8LikxprGd8l2vZV02eRBQ_3d_3d

After reading the directions, you will be prompted to enter your **PIN** # -----. If you have technical problems with the survey please contact me at deborahdclark@suddenlink.net .

Please accept my gratitude in advance for your cooperation and timely participation in this research study.

Deborah D. Clark

Deborah D. Clark
Marshall University Graduate Student

Appendix E: Contents of One-Week Follow-up E-mail Reminder

Email Subject: ***West Virginia Teachers' Technology Tools and Use Survey Request***

Last week you received a request to complete the *West Virginia Teachers' Technology Tools and Use Survey*. The online survey is seeking your opinion regarding the use of 21st century technology tools and factors influencing your ability to integrate technology into instruction. Your name was selected randomly from a list of West Virginia PK-12 full time teachers.

If you have already completed the survey, please accept my sincere thanks. If not, please do so by **DATE**. I am especially appreciative of your help. When people like you share your experiences and opinion, we can gain a better understanding of the use of 21st century technology tools in West Virginia schools.

The survey can be accessed by clicking on the following link.

http://www.surveymonkey.com/s.aspx?sm=f8LikxprGd8I2vZV02eRBQ_3d_3d
In order to begin the survey, you will be prompted to enter your **PIN # ----**.

If you have questions, please contact me at 304-466-3982 or by email at deborahdclark@suddenlink.net .

Deborah D. Clark
Marshall University Graduate Student

Appendix F: Contents of Email Reminder That Deadline is Approaching

SUBJECT: ***West Virginia Teachers' Technology Tools and Use Survey Request***
This is to remind you that the deadline is quickly approaching to complete the ***West Virginia Teachers' Technology Tools and Use Survey.*** On **DATE,** you received a request to complete an online survey seeking your opinion about the use of 21st century technology tools. Your name was selected randomly from a list of West Virginia PK-12 full time teachers. The deadline to complete the survey is **DATE.**
If you have already completed the survey, please accept my sincere thanks. If not, please do so by **DATE**. I am especially appreciative of your help. When people like you share your experiences and opinion, we can gain a better understanding of the use of 21st century technology tools in West Virginia schools.
The survey can be accessed by clicking on the following link.

http://www.surveymonkey.com/s.aspx?sm=f8LikxprGd8I2vZV02eRBQ_3d_3d
In order to begin the survey, you will be prompted to enter your **PIN # ----**.

If you have questions, please contact me at 304-466-3982 or by email at deborahdclark@suddenlink.net .

Deborah D. Clark
Marshall University Graduate Student

Appendix G: Contents of Packet for Non-Responders

DATE
NAME
PIN#
SCHOOL

About three weeks ago I sent a survey to you that asked about your use of 21st century technology tools. My records indicate that your survey has not been returned. If you have already completed the survey, please disregard this letter.

The results of the survey may be very useful to state leaders and other policy makers. While your participation is voluntary, your response will greatly increase the strength of the study. Although I sent surveys around the state, it is important to hear from everyone in the sample so that the results are representative of the entire state.

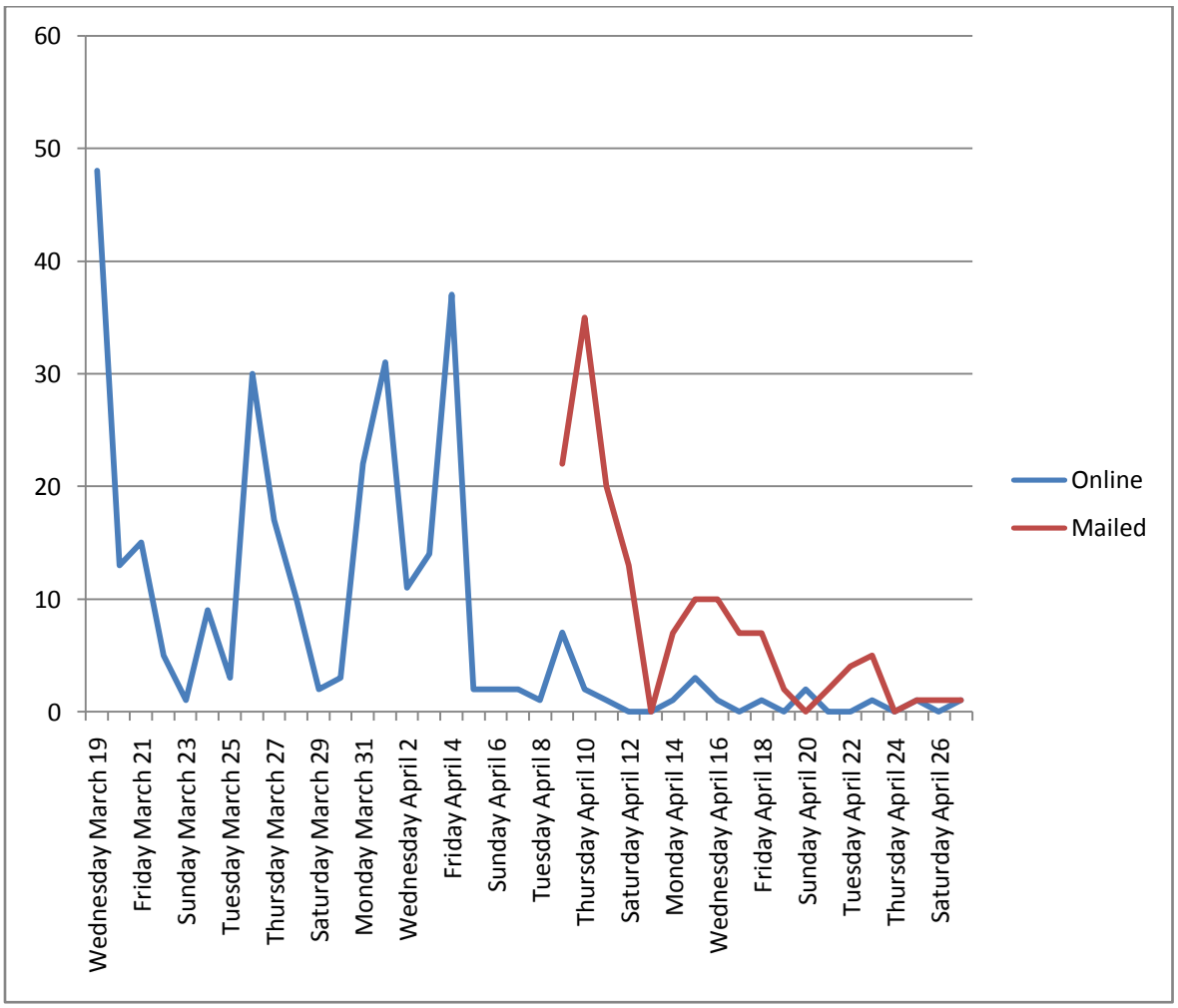
Protecting the confidentiality of every person is important to me. The number included on the survey is used only for me to check your name off the mailing list when it is returned. The list is then destroyed so that individual names cannot be connected to the results in any way. Your participation is purely voluntary and there is no penalty for declining to participate.

I hope that you will complete the enclosed survey and return it by **DATE** using the stamped, self-addressed envelope. Please contact me at 304-466-3982 or by email at deborahdclark@suddenlink.net if you have any questions or if would like additional information about this study.

Thank you very much for taking time from your busy schedule to help with this important study.

Deborah D. Clark
Marshall University Graduate Student

Appendix H: Return Rate Graph



Appendix I: Distribution of Responses for 21st Century Technology Tools

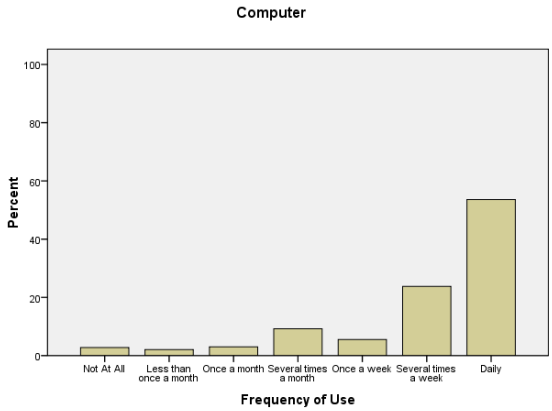


Figure 1. Frequency of Computer Use

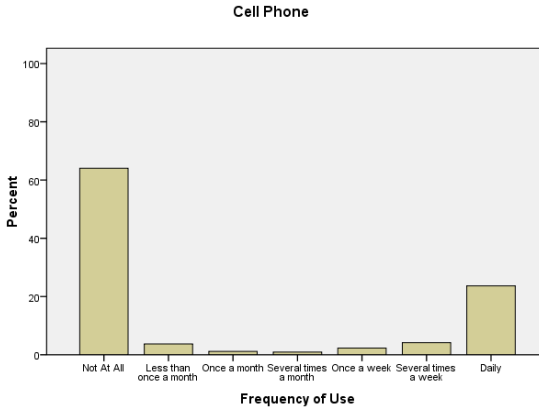


Figure 2. Frequency of Cell Phone Use

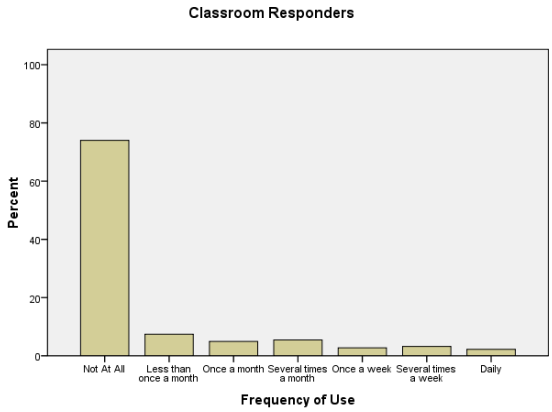


Figure 3. Frequency of Classroom Responder Use

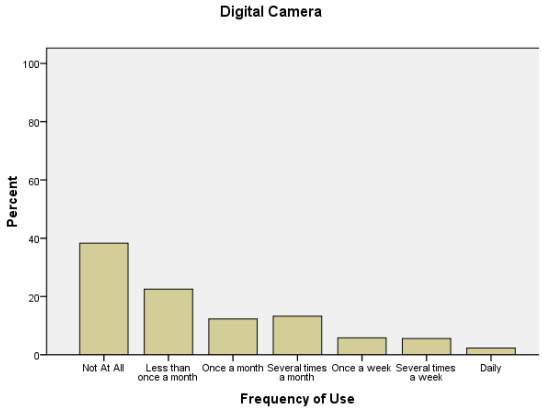


Figure 4. Frequency of Digital Camera Use

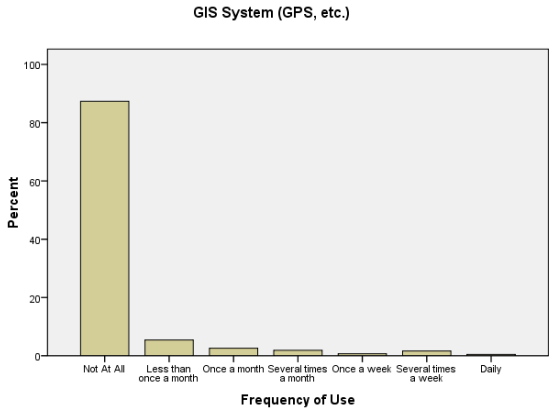


Figure 5. Frequency of GIS System Use

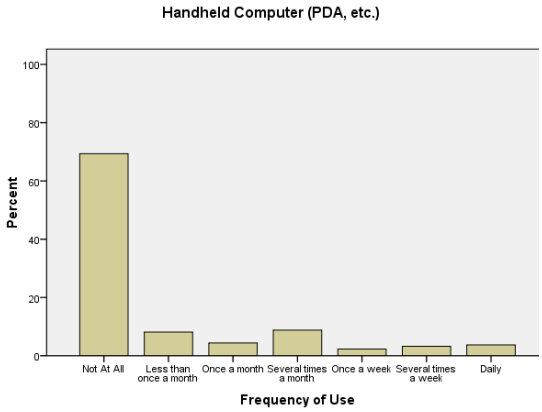


Figure 6. Frequency of Handheld Computer Use

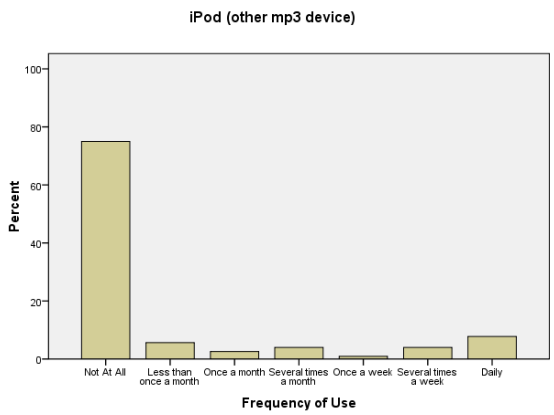


Figure 7. Frequency of iPod (other mp3) Use

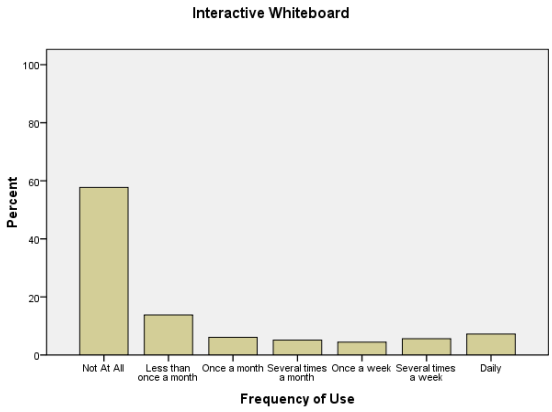


Figure 8. Frequency of Interactive Whiteboard Use

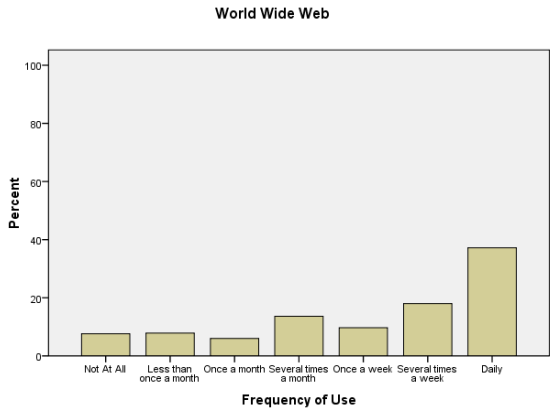


Figure 9. Frequency of World Wide Web Use

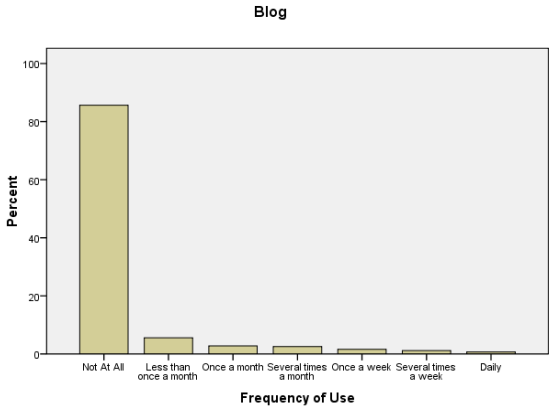


Figure 10. Frequency of Blog Use

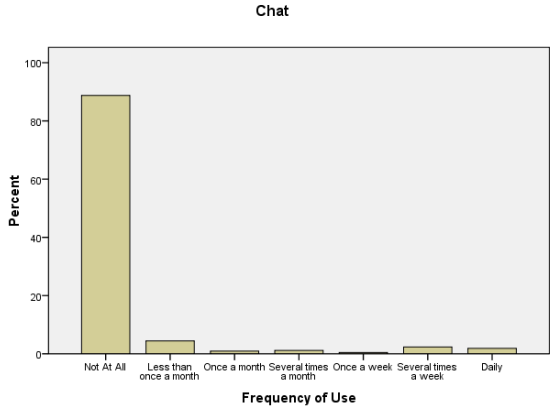


Figure 11. Frequency of Chat Use

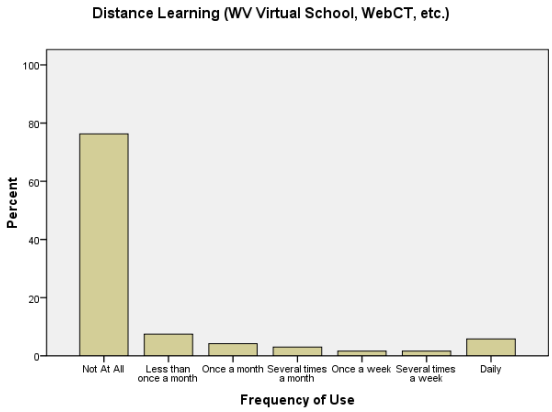


Figure 12. Frequency of Distance Learning Use

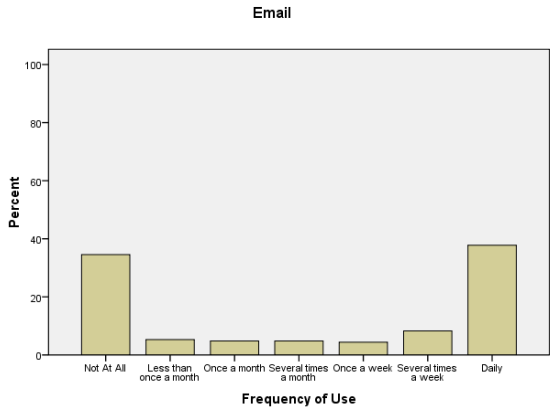


Figure 13. Frequency of Email Use

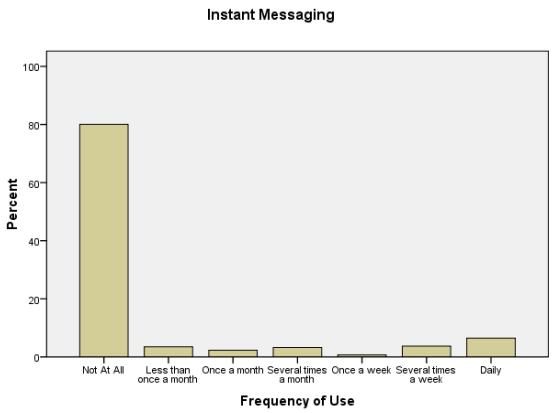


Figure 14. Frequency of Instant Messaging Use

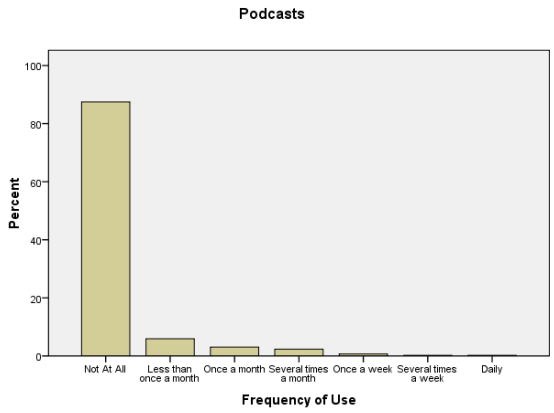


Figure 15. Frequency of Podcasts Use

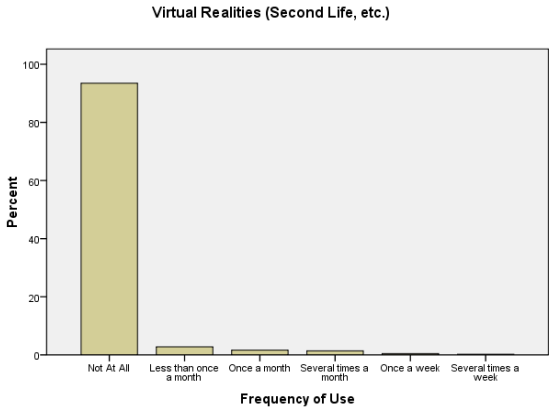


Figure 16. Frequency of Virtual Realities Use

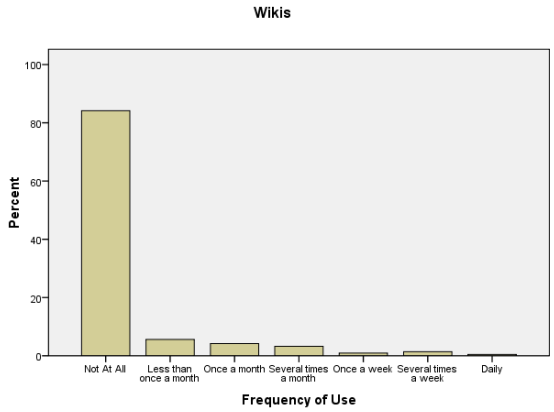


Figure 17. Frequency of Wikis Use

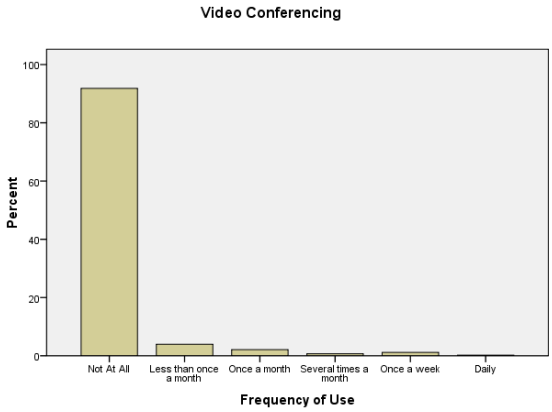


Figure 18. Frequency of Video Conferencing Use

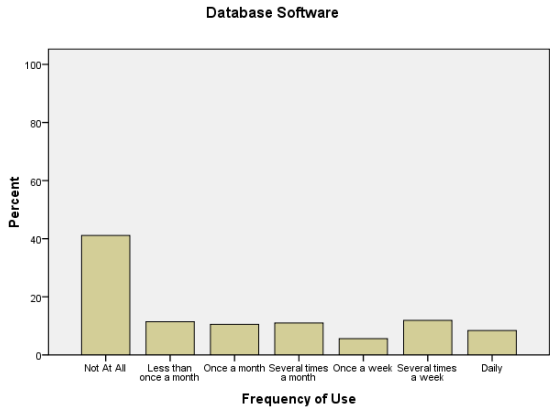


Figure 19. Frequency of Database Software Use

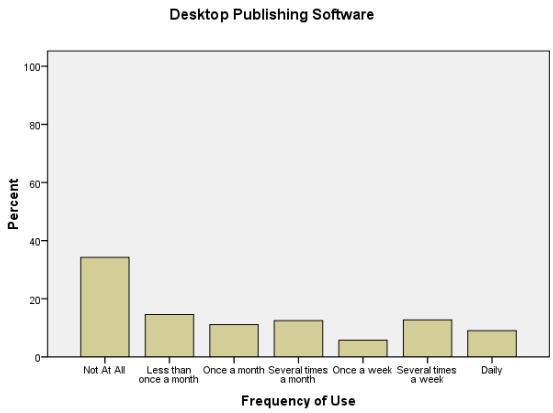


Figure 20. Frequency of Desktop Publishing Software Use

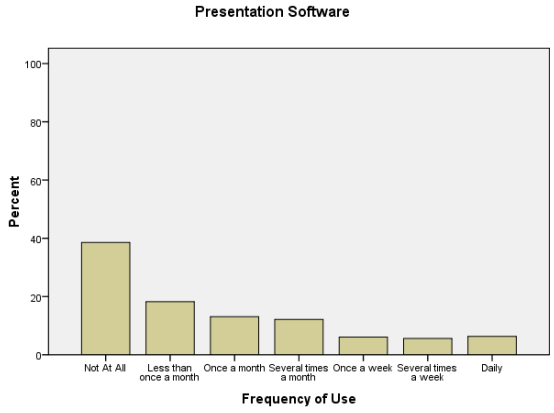


Figure 21. Frequency of Presentation Software Use

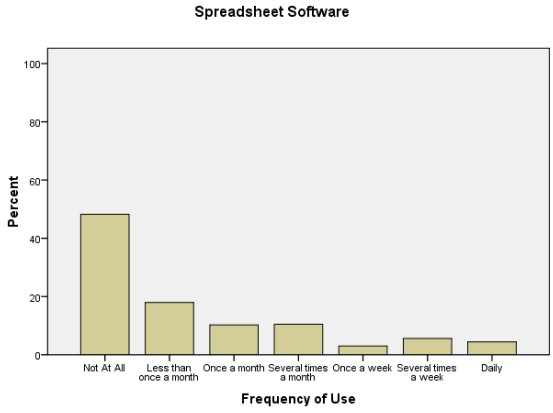


Figure 22. Frequency of Spreadsheet Software Use

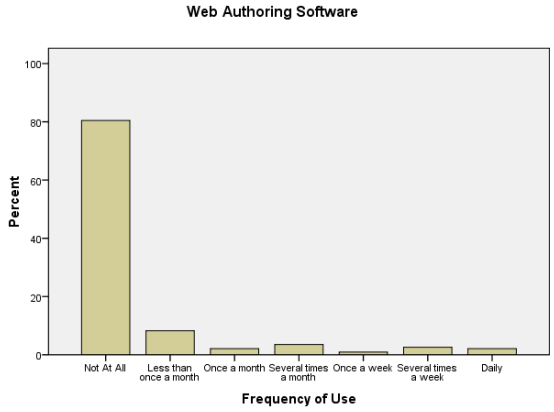


Figure 23. Frequency of Web Authoring Software Use

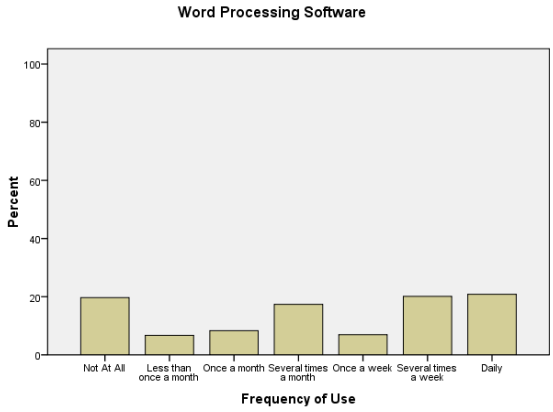


Figure 24. Frequency of Word Processing Software Use

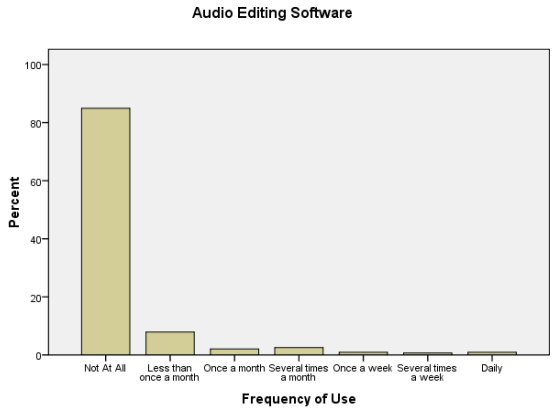


Figure 25. Frequency of Audio Editing Software Use

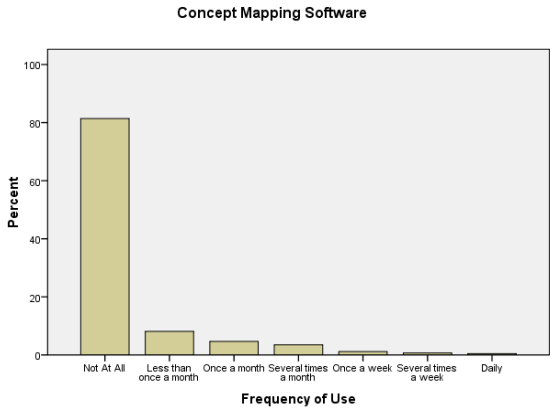


Figure 26. Frequency of Concept Mapping Software Use

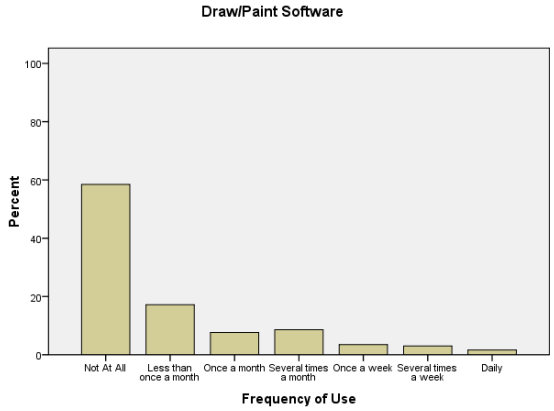


Figure 27. Frequency of Draw/Paint Software Use

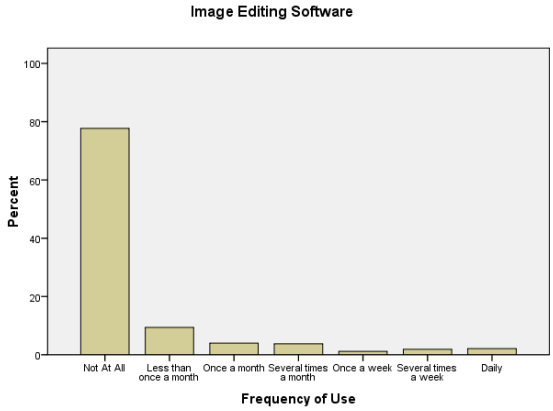


Figure 28. Frequency of Image Editing Software Use

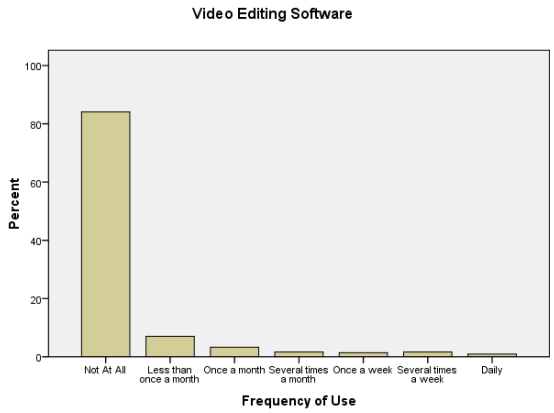


Figure 29. Frequency of Video Editing Software Use

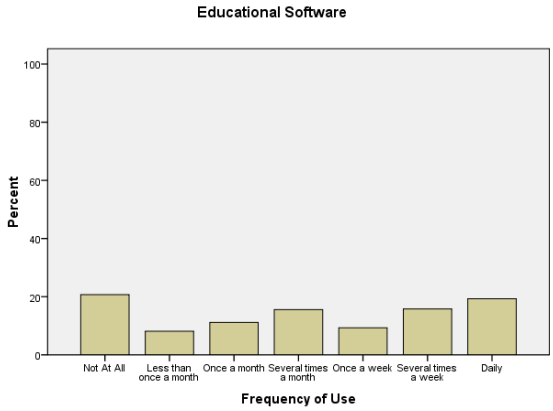


Figure 30. Frequency of Educational Software Use

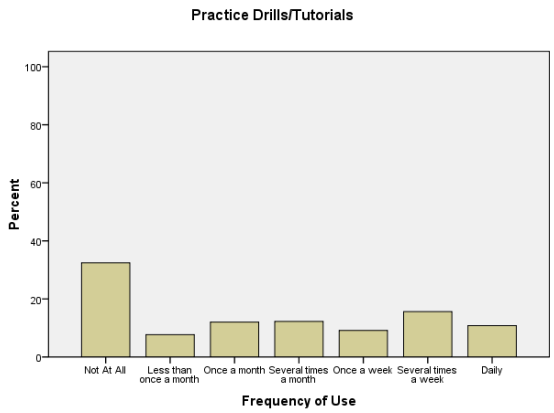


Figure 31. Frequency of Practice Drills/Tutorials Use

Appendix J: Distribution of Responses for Creating a 21st Century Context

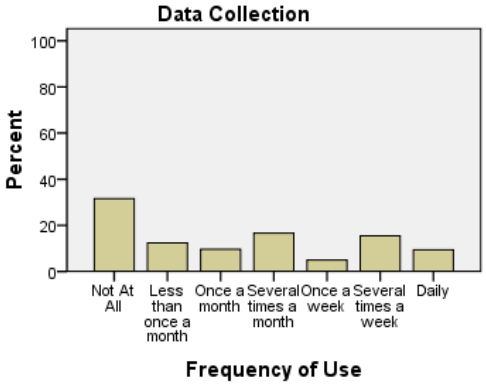


Figure 32. Frequency of Data Collection

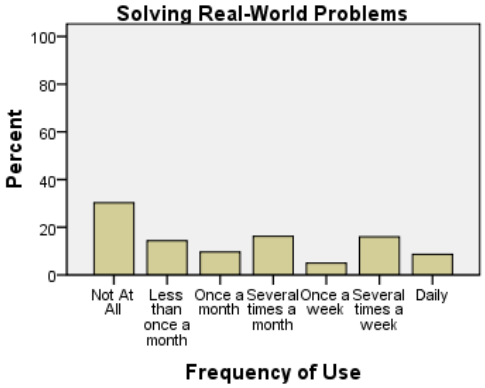


Figure 33. Frequency of Solving Real-World Problems

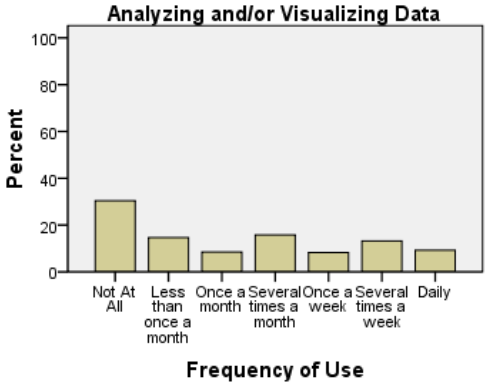


Figure 34. Frequency of Analyzing and/or Visualizing Data

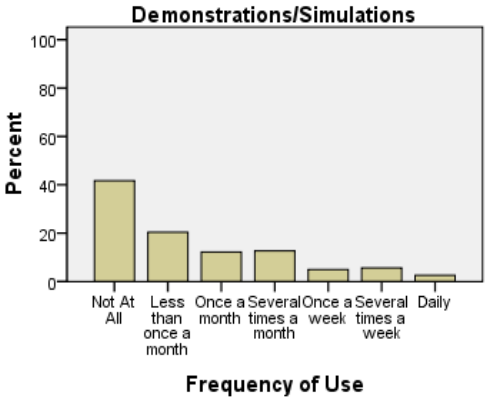


Figure 35. Frequency of Demonstrations/Simulations

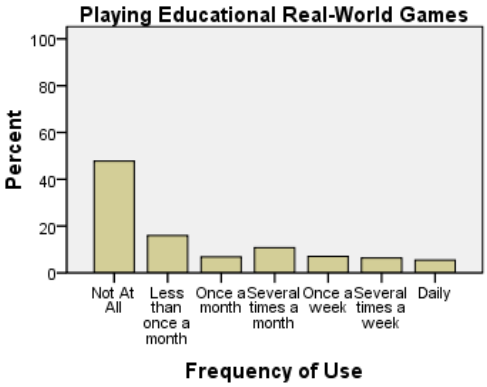


Figure 36. Frequency of Playing Educational Real-World Games

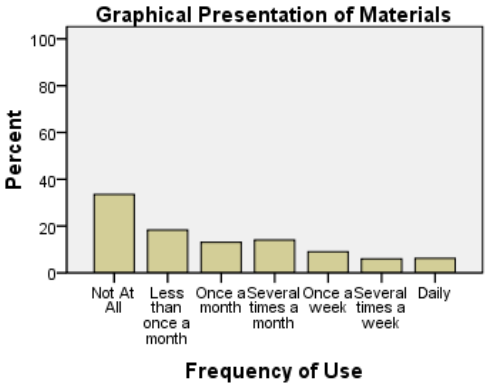


Figure 37. Frequency of Graphical Presentation of Materials

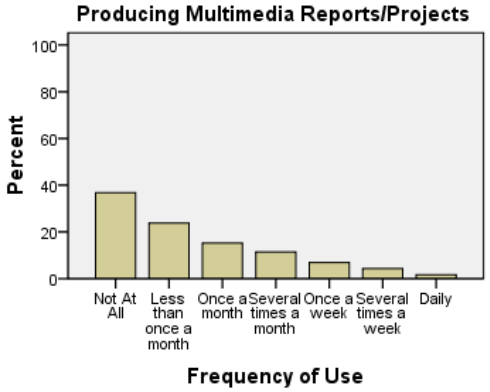


Figure 38. Frequency of Producing Multimedia Reports/Projects

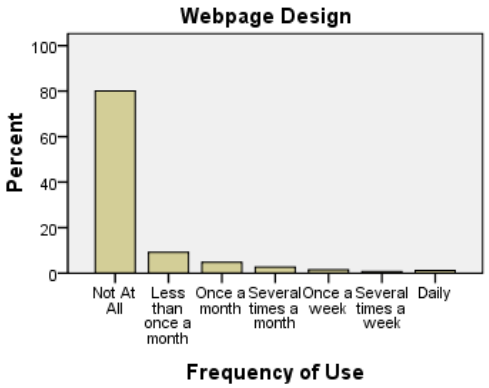


Figure 39. Frequency of Webpage Design

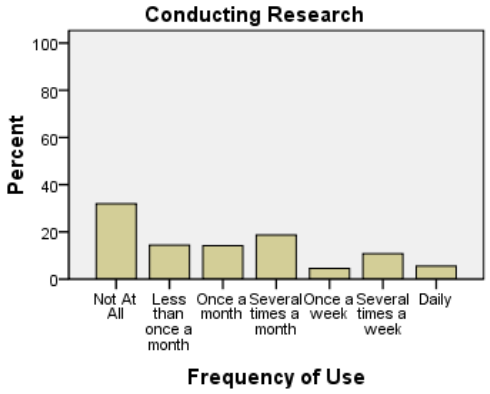


Figure 40. Frequency of Conducting Research

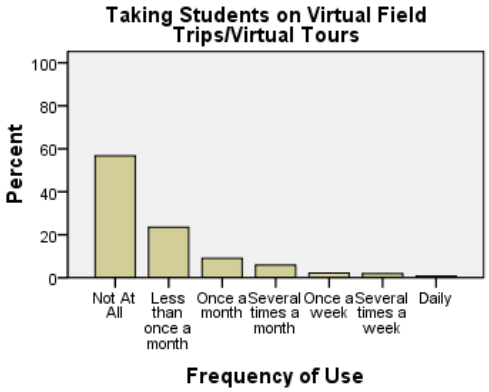


Figure 41. Frequency of Taking Students on Virtual Field Trips

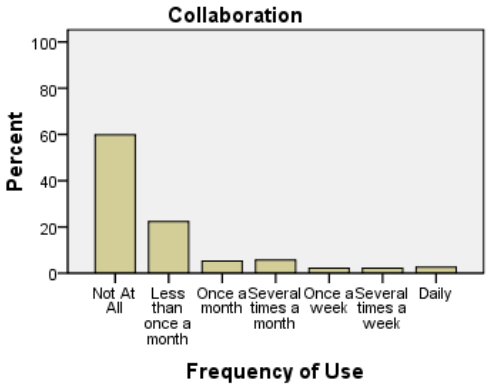


Figure 42. Frequency of Collaboration

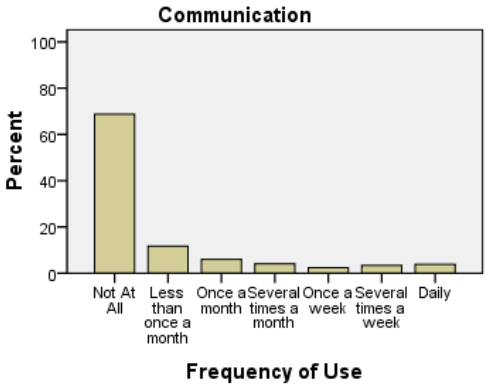


Figure 43. Frequency of Communication

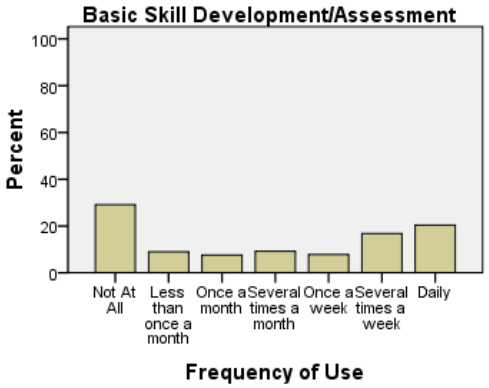


Figure 44. Frequency of Basic Skill Development/Assessment

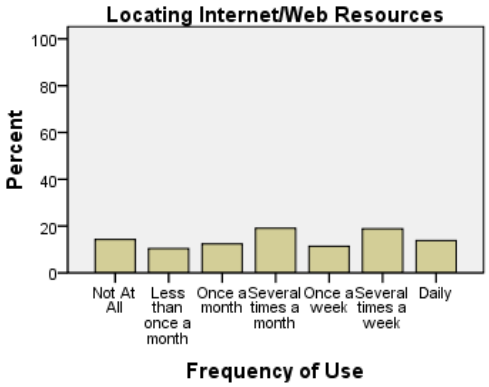


Figure 45. Frequency of Locating Internet/Web Resources

CURRICULUM VITAE

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Route 1, Box 320
Hinton, WV 25951
clarkd@marshall.edu
1-304-466-3982
August 4, 2008

BACKGROUND AND EXPERIENCE

FORMAL AND CONTINUING EDUCATION

Marshall University
BA Education. Certification - Elementary Education, Math 1-9

Marshall University Graduate College
MA Elementary Education
MA Early Childhood Education
Middle Childhood Authorization
Math Thru Algebra I Certification
National Board for Professional Teaching Standards – EA Mathematics
Ed.S. Curriculum and Instruction - Educational Computing
Ed.D. Curriculum and Instruction - Educational Computing

TEACHING/WORK EXPERIENCE

Edvantia
March 2005-Present
Consultant, STEM Fusion Force
Codirector/Mathematics Content Specialist
Coalfield Rural Systemic Initiative (CRSI)

RESA I
2002-2007
Project InSTEP Regional Coordinator
Facilitator MUGC Appalachian Accomplished Teaching Project for NBPTS

West Virginia Department of Education
2001-2002
Project MERIT Regional Mentor Teacher

Summers County Board of Education
1970-2001
Pence Springs Elementary, Jumping Branch Elementary, Bellepoint Elementary, Hinton Jr. High, Hinton Sr. High, Talcott Elementary School, and Summers Middle School.

Summers County Board of Education, Alternative After School Education, Homework Helper, Aftermath, and ABE Computer Literacy
1991-2002
After school tutoring and computer education programs

West Virginia University, Marshall University Graduate College, and Salem-Teikyo University

1998-2008

Teacher Training Policy 5100
Phase I Professional Development
Using Handheld Computers in the Classroom
Learning and Teaching With Web 2.0
Transforming the Classroom With Project-Based Learning

Marshall University Graduate College

1997-2008

Instructor, RuralNet
Instructor, CIEC 560, CIEC 580, CIEC 600, CIEC 561, CIEC 564, and CIME 561

University of Charleston

1984-1985

College Algebra and Math 100

PROFESSIONAL AND COMMUNITY ACTIVITIES

Awards and Honors

2002 WVDE and Summers County Schools Recognition for National Board Certification EA Mathematics
2001 National Board Certification Early Adolescent Mathematics
2001 State Level Awardee Presidential Award for Excellence in Mathematics Teaching
2001 RESA I Coalfield Science, Math, Technology Consortium Board
2001 PTTT Facilitator (Preparing Tomorrow's Teachers to use Technology) Bluefield State College
2000 Project IMPACT
2000 WV Technology Literacy Challenge Fund Grant Award Recipient
2000 SUCCESS 2000: Strategies for Success Facilitator
2000 State Level Awardee Presidential Award for Excellence in Mathematics Teaching
1999 Compaq's Teaching with Computer Technology Grant Program Awardee
1999 RuralNet, Lead Teacher Award and Outstanding Instructional Plan Award
1998 Featured in T.I.M.E., Texas Instruments "TI-73 Passes the Test in Hinton, WV"
1998 Project MERIT Lead Teacher
1998 Policy 5100 ISTE Technology Standards for Teachers "Train the Trainer"
1997 Featured in Chronicle of Philanthropy, January 15, 1998 issue "Wiring Schools for Success"
1997 American Heroes in Education Nominee
1996 WVDE/IBM Reinventing Education Grant Awardee
1995 Nominee, Presidential Award for Excellence in Mathematics Training
1995 CATS Science Mentor Teacher
1993 WV Council of Professional Educators Candidate
1992 Nominee for Outstanding Science/Math Teacher of West Virginia
1992 West Virginia Teacher's Academy

Workshops and Conferences

SITE Annual Conference – San Antonio, TX, presenter 2007
ICME-10 International Conference of Mathematics Educators – Copenhagen, Denmark, presenter 2004
Palm PETC Training – San Diego, CA
Project InSTEP (Integrating Strategies and Technology into Educational Practice) Facilitator
Project MERIT (Mathematics Education Reform Initiative for Teachers) Institutes
Marco Polo Train the Trainer – Huntington, WV
MARS Balanced Assessment – Michigan State University
Show Me Center Conference – Atlanta, GA
NCSM Leadership Conference – Wheeling, WV
WVCTM - Athens, WV - Wheeling, WV - Fairmont, WV - Flatwoods, WV, presenter 2001& 2002
NCTM Regionals - Charleston, WV-Richmond, VA-Pittsburgh, PA presenter
NCTM Nationals – Chicago, IL (presenter 2000) - San Francisco, CA - Washington, DC - Las Vegas, NV
Windows NT Administrator Training - Productivity Point, Charleston, WV
WVAMLE (WV Association for Middle Level Educators), presenter 1999, 2001, and 2002
Bell-Atlantic World School Conference - presenter
CLASSROOMS, INC. - Training for Site Coordinators, Morgantown, WV
NASA LERC IITA - Computer Workshop for Teachers, Cleveland, OH
SUMMIT '97 - Learning With Laptops (sponsored by Microsoft and Toshiba), Atlanta, GA
The School as a Home for the Mind Seminar, Indiana University, PDK Headquarters
WVSTA - Huntington, WV- Morgantown, WV- Snowshoe Resort, WV
Middle School Probability & Statistics Seminar - Wheeling Jesuit College, Wheeling, WV

Professional Organizations

National Council of Teachers of Mathematics (NCTM)
West Virginia Council of Teachers of Mathematics (WVCTM)
National Council of Supervisors of Mathematics (NCSM)
Association for Supervision and Curriculum Development (ASCD)
Delta Kappa Gamma Society - Secretary
Business and Professional Women
West Virginia Association of Middle Level Educators - Board of Directors (WVAMLE)

Selected Publications

Clark, D. (2007). Facing the challenge of developing an online "Tech Standards for Teachers" course. In C. Crawford, et al. (Eds.), *Proceedings of Society for Information Technology and Teacher Education International Conference 2007* (pp. 2302-2309). Chesapeake, VA: AACE.

Heaton, L., Orr, S., Young, D., Clark, D., Lewis, R., Singleton, R., Billheimer, D., & Sigman, K. (2007). Technology use and professional growth through the residency portfolio, Part 1. In C. Crawford, et al. (Eds.), *Proceedings of Society for Information Technology and Teacher Education International Conference 2007* (pp. 81-85). Chesapeake, VA: AACE.

Heaton, L., Orr, S., Young, D., Clark, D., Lewis, R., Singleton, R., Billheimer, D., & Sigman, K. (2007). Technology use and professional growth through the residency portfolio, Part 2. In C. Crawford, et al. (Eds.), *Proceedings of Society for Information Technology and Teacher Education International Conference 2007* (pp. 81-85). Chesapeake, VA: AACE.

Selected Presentations

Clark, D. (2007). Facing the challenge of developing an online "Tech Standards for Teachers" course. Paper presented at the 17th International Conference of the Society for Information Technology and Teacher Education, San Antonio, TX.

Heaton, L., Orr, S., Young, D., Clark, D., Lewis, R., Singleton, R., Billheimer, D., & Sigman, K. (2007). Technology use and professional growth through the residency portfolio, Part 1. Paper presented at the 17th International Conference of the Society for Information Technology and Teacher Education, San Antonio, TX.

Clark, D., & Heaton, L. (June, 2006). Data collection and analysis using Excel. Presentation at the Governor's Academy for Teaching Excellence, Parkersburg, WV.

Clark, D. (July, 2006). Using Geometer's Sketchpad effectively. Presentation at the Governor's Academy for Teaching Excellence, Princeton, WV.

Clark, D. (January, 2006). Using Inspiration® to meet standards. Presentation at the Coalfield Rural Systemic Initiative Teacher Leader Conference, Princeton, WV.

Clark, D. (2005). *Palm Educational Training Coordinators (PETC): Using handheld computers in the classroom.* Presentation at the National Educational Computing Conference, Philadelphia, PA.

Clark, D., & Watts, K. (2005). *Beyond the basics with T^3: tools, techniques, technology.* Presentation at the Math Coaches Make a Difference Conference, West Virginia Department of Education, Beckley, WV.

Billheimer, D., Clark, D., & Cockrille, D. (2004). *Developing learning communities.* Presentation at the 10th International Conference on Mathematical Education, Copenhagen, Denmark..

Landin, D. Clark, D. Munza, D., & Wilson, B. (2000). *Reinventing education: Good math websites.* Presentation at the National Council of Teachers of Mathematics Annual Conference, Chicago, IL.