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Computer use and integration of elementary school teachers

Samuel L. Smith
Rowan University

COMPUTER USE AND INTEGRATION OF ELEMENTARY SCHOOL TEACHERS

by
Samuel L. Smith

A Thesis

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Acknowledgments

I would like to give all honor and praise to my LORD and savior Jesus Christ who made if possible to complete this journey. With him all things are possible. Next I would like to thank my wife Shirley who has been there for me with love and encouragement. And last but not lease to Dr. Molinari my advisor, who has guided and encouraged me through out this entire program. Dr. Molinari you have been a blessing to me, thank you.

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ABSTRACT

Samuel L. Smith
Computer Use of Elementary School Teachers
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Dr. Louis Molinari, Advisor
Educational Technology

The problem in this study asks: Could it be that teachers who have high frequency of computer use in the classroom have recognizable characteristics than teachers who have a low frequency of computer use in the classroom?

A data collection instrument was develop and distributed to 23 classroom teachers at H. B. Wilson Elementary School in Camden, New Jersey. The 47 questions on the survey assessed computer knowledge and uses in the classroom. and a score was given to each category. Some of recognizable characteristics of teachers who had high frequency of computer use in the classroom were the fact that they had more professional development hours, basic knowledge of computer hardware and software. The teachers' personal experience with computers and software programs were also characteristics that were noted in the results. The result from this survey was compared to the report from the U.S. Department of Education, National Center for Education Statistics as mentioned in this paper.

Since the null hypothesis stated that there would be no significant difference in the characteristics of those teachers who have high frequency of computer use in the classroom than those who have low frequency, the null hypothesis was rejected.

Chapter 1

Significance of the Study

In the past few years, a flood of standards has engulfed education. Standards in content areas, such as reading, writing, mathematics, and science, have emerged at the state and national level. In some cases, these standards are tied to accountability via funding, student advancement, or certification. For example, the Department Education Commission of the United States estimated that at least 23 states would require students to pass a standard exam to graduate in 2002 (National Center for Policy Analysis, 1999). In addition, President Bush signed the No Child Left Behind Act of 2001 in January 2002. This law requires all states to establish a system of tests to measure students' achievement. In particular, it mandates tests in reading and math for students in grades three through eight, beginning in 2004. In 2005, science testing must begin ("Bush signs education reform law," 2002). The Enhancing Education through Technology Act of 2001, which is Title II, Part D of No Child Left Behind, provides grants for states that meet specific requirements to integrate technology in the curriculum. One of the requirements is that the grant application must include a description addressing "how the State educational agency will ensure ongoing integration of technology into school curricula and instructional strategies in all schools in the State, so that technology will be fully integrated into the curricular and instruction of the schools by December 31, 2006" (Title II, Part D§2413).

Concurrent with the "standards movement," government officials and educators advocated the need to emphasize technological skills (Trotter, 1997). Rather than

focusing on hardware and programming, these skills (often referred to as technological literacy) involved using technology as a tool to communicate, conduct research, and solve problems. Several states took the initiative to set technology benchmarks for various grade levels, and several national organizations undertook the mission of developing national standards for both students and teachers (Bennett, 2000: Roblyer, 2000).

In 1998, the International Society for Technology in Education (ISTE) published their National Educational Technology Standards (NETS) for Students, and, in 2000, published standards for teachers. As of March 2003, 29 states had adopted, adapted, or aligned with the ISTE standards for students, and 30 states were using the ISTE standards for teachers (ISTE, 2003).

An emphasis on pedagogical knowledge over technical skills (Sandholtz & Reilly, 2004) suggest that the more that teachers know about how students learn (Bransford, Brown, & Cocking, 2000), the more they will be able to employ a variety of teaching strategies–including a wide range of technology based tools–to address the learning needs of every student. So part of the challenge at hand consists in identifying the pedagogical theories and practices that are best suited to assist teachers in creating the learning environments where all learners can flourish, with access to resources and tools (including technology) that effectively support both the teachers' practice and the students' learning.

Every school and district can be seen as an "ecosystem" (Zhao & Frank, 2003) that influences the levels of teachers' computer use within it. Although Zhao and Frank (2003) found in their study that "most of the variation in computer use fell within ecosystems rather than between them" (p.823), other research (e.g., Achinstein, Ogawa,

& Speiglman, 2004) found differences in the "level of teacher control over instruction" (p.591) among districts, (and by extension, among schools,) and supports the notion that "district contexts deeply affect teacher learning" (p.594).

In addition to teacher training in the use of technology, the literature suggests that teachers should become an integral part of the technology development processes. When educators are not an integral part of these processes the existence and advancement of technology diminishes and may lead to extinction. (Dugger 1997) When educators are involved in the technology development processes, Polka (1997) believes changes to educators' homeostasis occur. Educators, as do most people, develop a homeostasis, a perceived balance or sense of comfort in their lives. Change upsets this perceived balance by uncertainty to a previously familiar lifestyle and results in perceived stress of the educator. Polka believes that if this change is perceived as enhancement to themselves, their families, and their organizations, the perceived stress generated by the change is minimized. In addition to Polka's attitudinal enhancement, Cooley (1997 supports the attitudinal correlate of control by stating that teachers must be empowered in the decision-making processes regarding the usage of technology within their classrooms. He stated that when teachers had become an integral part of the decision-making processes prior to the installation of the infrastructure, it was found teachers were more enthusiastic and enjoyed the technology within their classrooms much more readily. Carroll (1997) believes teachers are the keys to technology usage and must be involved in the technology development processes by allowing them to create, to revise, and to develop instructional strategies. He reported that teachers find it difficult to use the

existing hardware and software in their curriculum since the existing hardware and software was not developed specifically for their curriculum.

With all the available research it is apparent that there are still may concerns regarding the appropriate way to train teachers in the use of technology. If we are to find the best way to meet the needs of each teacher and offer necessary training in order that students will meet the requirements of the No Child Left Behind Act as well as NETS we must first learn more about our teachers. Teachers are the gateway to integration of technology in the curriculum and the classroom.

Statement of the Problem

Could it be that teachers who have high frequency of use with computers in the classroom have different recognizable characteristics from those teachers that have low frequency of use in the classroom?

Purpose of the Study

The purpose of this study is to determine what, if any correlation exists between characteristics and attitudes of teachers that have a high frequency of use of integration in the elementary classroom and the teachers that have a use low integration frequency of use of computers in the elementary classroom.

Hypotheses

There will be no significant difference in characteristics and attitudes of teachers that have a high frequency of use of integration in the elementary classroom and the

teachers that have a low integration frequency of use of computers in the elementary classroom.

Method of the Study

A survey questionnaire will be developed and used as the data collection instrument. The survey will include questions regarding the ways teachers are currently using computers in their classroom as well as background information regarding teachers past experiences with computers and the types of training they have had. The surveys will be distributed to all the teachers at H. B. Wilson Elementary School. The data will be reviewed, analyzed, studied and interpreted.

Limits of the Study

This study will be conducted at one elementary school. The survey will be done for a short duration of time so this study could not be used to apply to a larger or different population. Computers use in the classroom was the main focus of this study.

Definition of Terms

Integration – In reference to computers this means incorporating computers into the classroom in a meaningful way.

ISTE – International Society for Technology in Education is a not-for-profit organization dedicated to supporting the use of the information technology to aid in learning, and teaching of K-12 students and teachers.

National Educational Technology Plan – This is the United States vision of what is needed to prepare the nation's students for effective use of technology in elementary and secondary education.

NCLB – No Child Left Behind. This is the common term used to describe the revised Elementary and Secondary Education Act, which is a blend of requirements, incentives and resources for states in the United States.

NETS – National Education Technology Standards. Provides educators with criteria to use and factors to consider for better implementation of technology in public education in the United States.

New Jersey Technology Standards – Standards, benchmarks that have developed to assure that all students are computer literate.

Organization of the Study

Chapter I consist of an overview of the study and indicate the significance of the study. It constitutes a statement of the problem, the purpose of the study, the hypothesis tested, the methods and procedures employed, limitations of the study, a definition of terms, and a description of the organization of the thesis.

Chapter II is a review of the literature related to topics in the study. Chapter II evaluates the No Child Left Behind Act, signed into law in January 2002. The revised law includes the requirement that all students must be technologically literate by the end of eighth grade. It also examines research on characteristics of teachers' frequent use of computers and the Internet in the classroom.

Chapter III describes the design of the study, the questionnaire and the population surveyed for the study.

Chapter IV presents the data received and analyzes the statistical implications of the data in regard to the hypothesis.

Chapter V summarizes the findings of the preceding chapters, draws conclusions about the data, and makes recommendations for further study.

Chapter 2

Review of the Literature

The No Child Left Behind Act, signed into law in January 2002 is the latest reauthorization of the 1985 Elementary and Secondary Education Act. The revised law includes the requirement that all students must be technologically literate by the end of the eighth grade. In June of 1998, the National Education Technology Standards (NETS) for students were released. In June 2000 NETS for teachers were released followed by NETS for Administrators (TSSA) in November 2001. As of May 2004, 49 of the 51 states (including the District of Columbia) have adopted, adapted, aligned with, or otherwise referenced at least one set of these standards. In January of 2005, former Secretary of Education, Rod Paige, officially presented to Congress the new National Education Technology Plan. This plan establishes a national vision and strategy that supports effective use of technology. All of these initiatives point to the fact that the educational system is now required to implement technology. There is no longer an opportunity for schools to choose to use technology. These requirements are part of a national vision to improve students' academic achievement as well as prepare them for the 21st century.

With these new challenges now facing the educational system, schools and teachers will be looking for ways to implement technology into the curriculum. One of the major focuses must be on training teachers so they will be able to meet these requirements. Training opportunities enable teachers to build skills, gain confidence and learn strategies to integrate computers into their curriculum. It is necessary for teachers

to become knowledgeable about technology in order to teach their students (Piotrowski, 1992).

The implementation of computer and telecommunications technologies in schools has long been a national, state, and local educational, goal (Glennam & Medmen, 1996; National Task Force on Educational Technology, 1984, as cited in Reiber & Welliver, 1989). American public education has invested dearly in these technologies, wiring buildings, classrooms, and accumulating an impressive computer inventory (Becker, 2000b; Office of Technology Assessment, 1995). This substantial public investment underscores society's expectation that education will successfully integrate technology into the classroom. However, integrating technology into schools and using it in ways that impact student learning is proving more difficult than expected (Scheffler & Logan, 2000, citing Houghton, 1997).

Two pieces of information help inform an understanding of the current state of teacher technology integration in public schools. The first indicator a snapshot survey by the U.S. Department of Education (National Center for Educational Statistics, Fast Response Survey System, January 1999), revealed that 33% of teachers surveyed, reported feeling either well (23%) or very well (10%) and were prepared to teach technology in their subject area. Fifty-one percent reported feeling "moderately well prepared."

A second indicator is current measurements of teachers' level of technology implementation using Moerch's (1995) LoTi scale. LoTi registers teachers self-assessed level of technology integration on a scale of 0-6, zero being non-use. Recent LoTi survey results for New Hampshire teachers (Learning Quest, Inc., 2000) reveal that 31% of

teachers consider their integration skills to be at Level 3 (Infusion) or higher. Nationally, this number is 28%. Level 3, indicating technology use that complements selected instructional activities, is purposefully planned to enrich students learning, and does not merely reproduce written work in digital form. It seems safe to assume that the 33% of teachers who feel either "well" or "very well" prepared to use technology and the 31% of teachers who rate themselves at LoTi Level 3 or higher are one and the same when planning instructional activities. It is also unlikely that a teacher who does not feel well prepared to integrate technology would then rate their technology use as leaning toward the sophisticated side of the integration continuum.

A great deal of accumulated evidence has identified obstacles that impede teachers' ability to adopt and integrate technology into their teaching. These include the lack of time, expertise training, access, resources, and support (Leggett & Persichitte, 1998, as cited in Wilson, Sherry, Dobrovolny, Batty, & Ryder, 2000). However, other recent evidence indicate that a classroom teachers' lack of integration understanding (Jerald & Orlofsky, 1999, citing Chambers et al, 1999) is most troubling because the integration literature suggest, that technology's greatest impact on student learning appears only after teachers have sufficient skills coupled with an understanding of how various technologies can be used as cognitive tools, and are able to weave technology experiences into their daily practice. It is further suggested that this more robust level of understanding comes over time, as teachers have opportunities to practice with the technology and reflect on how these new tools fit in with their current instructional practices and their notions and beliefs about the nature of learning. No small task!

Despite the fact that the number of computers in teachers' classrooms has increased dramatically in the last 20 years (Office of Technology Assessment {OTA}, 1995, researchers and educators alike still report that integrating technology into classroom curricula is not easily accomplished as teachers preferred instructional methods that are traditional to their beliefs about teaching and learning (Hannafin &Savenye, 1993; Hativa & Lesgold, 1996).

Brickner (1995) extended the concept of first and second order change (Cuban, 1993; Fullan & Stiegelbauer, 1991) to categorize these obstacles as first and second order barriers to change. First order changes "adjust" current practice to make it more effective or efficient, leaving underlying belief unchallenged. Second order changes confront beliefs about current practice and lead to new goals, structures or roles. Barriers to change are "the extrinsic and intrinsic factors that affect a teacher's innovation implementation efforts" (Brickner, p.xvii). Thus first order barriers to technology integration are described as being extrinsic to teachers and include lack of access to computers and software, insufficient time to plan instruction, and inadequate technical and administrative support. In contrast, second order barriers are intrinsic to teachers and include beliefs about teaching, beliefs about computers, established classroom practices, and unwillingness to change. If second order change is required for educational innovation to become practice (Cuban, 1993: Fullan & Stiegelbauer, 1991), it is important to examine how teachers' current classroom practices and beliefs support or inhibit classroom technology use. Clearly, changes in classroom practices will not occur simply because computers are more available in the classroom (i.e., first order barriers are eliminated). Baker (as cited in Miller & Olson, 1994) described teachers as viewing

the computer as either an inspiration or an intrusion depending on the meaning and values they assign to technology. For example, if the computer does not teach what the teacher stresses, teaches things the teacher does not, or requires types of intelligent activity the teacher does not emphasize, it is unlikely the teacher will assign high value to its use. On the other hand, if the teacher perceives that the computer addresses important instructional and learning needs, the perceived value will be higher.

Technology standards are not new in the education field. After microcomputers entered schools in the 1970s and 1980s, educators struggled with defining appropriate computer skills for students (Bitter, 1983). At the time, computer literacy was often equated with basic operations and programming. Although several states provided guidelines to benchmark computer literacy at different grade levels, they did not require students to meet such standards in order to graduate (Roblyer, 2000).

In the past few years, a flood of standards has engulfed education. Standards in content areas, such as reading, writing, mathematics, and science have emerged at the state and national level. In some cases, these standards are tied to accountability via funding, student advancement or certification. In addition, President Bush signed the No Child Left Behind Act of 2001 in January 2002. This law requires all states to establish a system of tests to measure students' achievement. In particular, it mandates tests in reading and math for students in grades three through eight, beginning in 2004. In 2005, science testing must begin ("Bush signs education reform law," 2002). The Enhancing Education through Technology Act of 2001, which is Title II, Part D of No Child Left Behind, provides grants for states that meet specific requirements to integrate technology in the curriculum. One of the requirements is that the grant application must include a

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In 1998, the International Society for Technology in Education (ISTE) published their National Educational Technology Standards (NETS) for Students and in 2000, the International Society for Technology in Education published standards for teachers. As of March 2003, 29 states had adopted or aligned with the ISTE standards for students, and 30 states were using the ISTE standards for teachers (ISTE, 2003).

Contrary to some highly vocal naysayers (e.g., Cordes & Miller, 1999; Healy, 1998; Oppenheimer, 1997; Stoll, 1995), computing technology can, under the right conditions, have a positive impact on learning and teaching in the primary and secondary grades (Honey, 2001; Norris, Smolka, & Soloway, 2000). In fact, there is a range of impacts, such as increased time on task, higher test scores, lower cost and increased motivation.

However, although the literature points to the potential for impact, the reality is sobering: to a first order approximation, the impact of computing technology over the past 25 years on primary and secondary education has been essentially zero (e.g., Cuban, 2001; Oppenheimer, 1998). Although specific classrooms or even schools can be identified where computing technologies have had an impact overall, looking across the landscape of schools in the United States, there are precious few lasting footprints left by the technology. By and large classrooms and schools go about their daily business ignorant of the profound changes caused by computing technologies in many other areas of everyday life, from new manufacturing practices to new scientific research methods, from new business practices to new methods for creating art and music. Why aren't our children and their teachers benefiting from technology?

One possible source of resolving this discrepancy may be found in teachers' responses to the "Snapshot Surveys," which have been conducted throughout the U.S. since 1997. Consisting of approximately four-dozen questions, the Snapshot Survey (www.snapshotsurvey.org) is a multidimensional survey of demographics, educator attitudes, classroom practices, and technology access.

By far, the single most significant predictor of technology use is the number of classroom computers. Also significant, but less marked so, are teachers' use of the Internet at school, the availability of curricular software, and the availability of adequate technical support to maintain operation status of computers and networks.

One thing we must do is revisit our state and national core content standards for students and teachers. Can we have science standards with no mention of technology when scientists rely so heavily on technology to do science? Can we have

English/Language Arts standards with no mention of technology when most anyone who writes a sentence in his or her job uses word processing, and anyone in the business word doing research goes to the Internet for information? We need to bring our curriculum up to 21st century reality. We need to assess our students' knowledge and skills in a way that is consistent with how that knowledge and those skills are used in the real world. This is the context in which we should be integrating technology throughout all of curriculum and instruction.

There is compelling evidence of an association between technology use and constructivist beliefs (Honey & Moeller, 1990; Becher, 2000, 2001), even to the point of increased technology use and adoption of constructivist practices occurring together (Sandholtz, Ringstaff, & Dwyer, 2000). However, it is not clear that technology causes teachers to adopt constructivist beliefs. Dexter, Anderson, and Becker (1999) found no support for the view that computers are a catalyst for instructional change and concluded that the view of computer as catalyst underestimates the impact of teachers' beliefs on how they teach, simplify the process of professional growth and diverts attention from examination of how social norms and structures influence change. In their view, if teachers decide to use the computer in a constructivist manner, they do so, not because of features inherent in the technology, but on the basis of their knowledge and expertise.

In reviewing the research on changing teachers' beliefs, Murphy (2000) noted that it was a complex process because beliefs appear to be static, resistant to change, and generally not affected by reading and applying research. Pajares (1992) noted that change is easiest for new beliefs and that "change in beliefs follows, rather than precedes, change in behavior." This suggests then, that teachers' practices (e.g., use of technology)

may actually lead to changes in beliefs about teaching. Similarly, Kagan (1992) proposed that teachers form the ideas on which their beliefs are based from practice, both their own and that of their peers, rather than through reading and applying research.

An emphasis on pedagogical knowledge over technical skills (Sandholtz & Reilly, 2004) suggest that the more teachers know about how students learn (Bransford, Brown, & Cocking, 2000), the more they will be able to employ a variety of teaching strategies–including a wide range of technology based tools–to address the learning needs of every student. So part of the challenge at hand consists in identifying the pedagogical theories and practices that are best suited to assist teachers in creating the learning environments where all learners can flourish, with access to resources and tools (including technology) that effectively support both the teachers' practice and the students' learning.

Every school and district can be seen as an "ecosystem" (Zhao & Frank, 2003) that influences the levels of teachers' computer use within it. Although Zhao and Frank (2003) found in their study that "most of the variation in computer use fell within ecosystems rather than between them" (p.823), other research (e.g., Achinstein, Ogawa, & Speiglman, 2004) found differences in the "level of teacher control over instruction" (p.591) among districts, (and by extension, among schools,) and supports of the notion that "district contexts deeply affect teacher learning" (p.594).

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educators' homeostasis occur. Educators, as do most people, develop a homeostasis, a perceived balance or sense of comfort in their lives. Change upsets this perceived balance by uncertainty to a previously familiar lifestyle and results in perceived stress of the educator. Polka believes that if this change is perceived as enhancement to themselves, their families and their organizations, the perceived stress generated by the change is minimized. In addition to Polka's attitudinal enhancement, Cooley (1997 supports the attitudinal correlate of control by stating that teachers must be empowered in the decision-making processes regarding the usage of technology within their classrooms. He stated that when teachers had become an integral part of the decision-making processes prior to the installation of the infrastructure, it was found teachers were more enthusiastic and enjoyed the technology within their classrooms much more readily. Carroll (1997) believes teachers are the keys to technology usage and must be involved in the technology development processes by allowing them to create, to revise and develop instructional strategies. He reported that teachers find it difficult to use the existing hardware and software in their curriculum since the existing hardware and software was not developed specifically for their curriculum.

Since 1994, the National center for Education Statistics (NCES) has documented the large increase in access to computers and the Internet in the nation's public elementary and secondary schools (U.S. Department of Education 2000). These increases have led to a need to understand the extent and types of teacher use of computers and the Internet, as well as teachers' perceptions of their own preparedness to use these tools in their classes. To address these critical information needs, NCES commissioned a survey using the Fast Response Survey System (FRSS) that was

conducted in the spring of 1999. The survey found that 99 percent of full-time regular public school teachers reported they had access to computers or the Internet somewhere in their schools.

Some of the characteristics of teachers use of computers and the Internet was apparent in this report. Teachers' use of computers or the Internet at school varied for some types of uses by school poverty level (the percent age of students in the school eligible for free or reduced price lunches). Teachers in schools with a school poverty level of less than 11 percent were more likely to use computers or the Internet "a lot" for creating instructional materials (52 percent) than teachers in schools with a school poverty level of 71 percent or more (32 percent). This pattern also held for teachers who used computers for administrative record keeping (43 versus 24 percent for the same groups). Other teacher characteristics that determine computer and Internet use in the classroom were the amount of professional development, types of assignments that were given to the students and the amount of teaching experience.

CHAPTER 3

Design of the Study

Setting

Camden, New Jersey comprises some nine square miles in southern New Jersey. Camden is less than one mile from downtown Philadelphia, Pennsylvania, 2 ½ hours driving time from Washington, D. C., and 90 miles from New York City and 52 miles from Atlantic City, New Jersey.

Some 80,000 people live in the city of Camden. The city has off campus sites for Universities; Rutgers, the State University of New Jersey; and Camden County College. . Camden boasts a medical school, major health care facilities, and the urban campuses of Rowan University.

In the late 1800's, the Camden City Public School System became a reality. Some of America's most well-known and renowned citizens are graduates of the Camden City Schools. Today, our K-12 school district numbers approximately 19,000 students attending 23 elementary schools, 5 middle schools, 2 traditional high schools, 2 magnet high schools, and an alternative high school.

As an "Abbott" district, challenges face the Camden City School. Our dedicated professional and educational support personnel are diligently working through whole school reform models and other innovative projects and programs, to improve the performance of district students on state mandated test and other performance measures

of Camden's population makes it a true urban center. Many famous historical and cultural sites dot the landscape of this reemerging northeastern urban center.

H. B. Wilson Elementary School is one of the 23 elementary schools in the Camden School district. Kindergartens through fourth grade classroom teachers were targeted for this study. Of the 23 classroom teachers at H. B. Wilson Elementary School 22 participated in the study. All the classroom teachers have technology in their classrooms.

Data Collection

In order to have maximum participation, I was given permission from the principal to distribute survey forms to each classroom teacher. The teachers were asked to answer each question with candor and honesty.

Description of the Instrument

A written survey was designed to determine if and how classroom teachers were using technology in their classrooms. Teachers were given multiple-choice questions regarding their technology use in their classrooms. They were also asked how they incorporated technology into their weekly lesson plans. The teachers' technology needs were also spotlighted in the questions. Additionally any technological needs of the teachers were addressed.

At H. B. Wilson School a technology coordinator assists the teachers with technology in their classrooms for clarity of purpose. The technology coordinator reviewed the questions before they were distributed.

The data collection instrument was a survey created specifically for the purpose of this study. There were a total of 47 questions and the survey was three pages long.

The first section of the survey instrument consisted of computer background questions. These questions included knowledge of components of computers, computer operating systems, computer applications, their personal comfort ability with solving computer problems when the computer was not working, their knowledge of computers when shopping for one and the teachers personal experience with popular programs.

The next section included questions about how teachers gain their computer knowledge. Was this knowledge from books, TV shows, trial and error, retail staff, co-workers, family members or workshops? Teachers were asked to what extent they believe that the following had prepared them to use computers: College/graduate work, Professional development activities, Colleague, Students and Independent Learning. The 5 categories for this question were; not at all, small extent, moderate extent, significant extent, and great extent.

The last questions dealt with how many hours of professional development (not college) in the use of computers the teachers had had in the last 3 years: 1-10 hours, 11-20 hours, 21-30 hours and 31 or more hours. What activity or application the teachers used most often with the students: Word processing, Internet, Web Quests, Practice drills, Scavenger hunts, Simulation games, Subject-specific software programs and research. The 1-5 categories for this question were: not at all, small extent, moderate extent, significant extent, and great extent, producing a possible total of 100. For each participant this number was used to determine what activities or applications teachers were most often using with their students in the classroom.

The Likert scale was used to assess 46 of the 47 questions of the survey. Each of the questions has a scale of 1-5, producing a possible total of 100.

As indicated in the literature review, a great deal of accumulated evidence has identified obstacles that impede teachers' ability to adopt and integrate technology into their teaching. These include: lack of time, expertise training, access, resources, and support.

The survey instrument was assessed for face and content validity. Four people were asked to give their opinions about the validity of the sections and the reliability of the questions. The judges consisted of a supervisor, a principal, tech coordinator and a teacher that is on the technology committee. Three of the judges have Master's Degrees and all of them have taken courses in the use of computers. All of the judges approved the instrument.

Relationship of the Instrument to the Null Hypothesis

The null hypothesis of the study states there will be no significant difference in the characteristics of those teachers who have high frequency of computer use in their classrooms and those teachers who have low frequency of computer use in their classrooms as determined by the Technology Survey prepared by the researcher specifically for this study. This survey was designed to specifically measure the frequency of computer use in the classroom by teachers. The purpose of the study was to determine what, if any correlation exists between the characteristics of teachers that have a high frequency of computer use in the classroom and the teachers that have a low

frequency of computer use in the classroom. Each characteristic was considered separately.

Since 1994, the National center for Education Statistics (NCES) has documented the large increase in access to computers and the Internet in the nation's public elementary and secondary schools (U.S. Department of Education 2000). These increases have led to a need to understand the extent and types of teacher use of computers and the Internet, as well as teachers' perceptions of their own preparedness to use these tools in their classes.

Summary

A 47-question survey instrument was created for this research project. The purpose was to assess any correlation between teacher characteristics and their frequency of computer use in the classroom. The survey was distributed to 100% of the teachers at H. B. Wilson Elementary School. Twenty-three teachers completed the survey (95%). A likert scale was used to assess the 46 questions of the 47 questions on the survey. The results was presented in light of the National center for Education Statistics (NCES) report that has documented the large increase in access to computers and the Internet in the nation's public elementary and secondary schools (U.S. Department of Education 2000). These increases have led to a need to understand the extent and types of teacher use of computers and the Internet, as well as teachers' perceptions of their own preparedness to use these tools in their classes.

Chapter 4

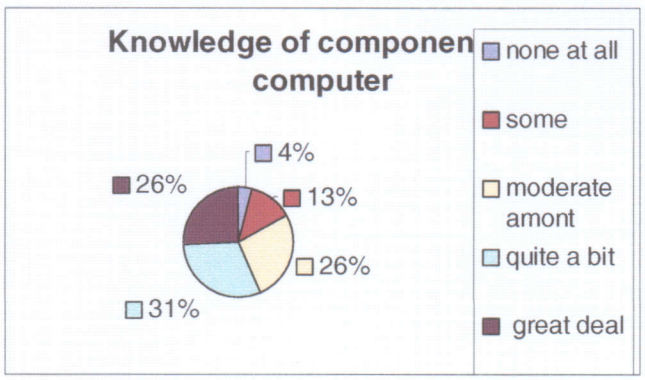
Analysis of the Data

The purpose of this study was to assess any recognizable characteristics between teachers who have a high frequency of computer use in the elementary classroom and teachers who have low frequency of computer use in the elementary classroom. The surveys were analyzed to determine if any recognizable characteristics existed. The sample used for this study was the teaching staff at H. B. Wilson Elementary School. The survey was distributed to the twenty-four teachers during a faculty meeting.

Twenty-three surveys were returned completed. This accounts for 95.8% of the staff of H. B. Wilson Elementary. The Camden City Board of Education has always fought to make technology high on its priories list.

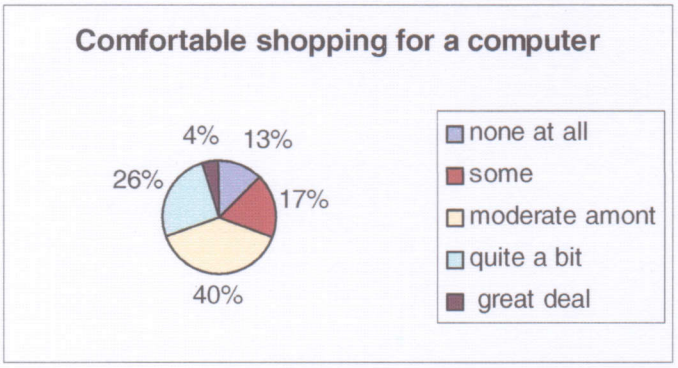
Teachers were asked how they felt about their knowledge of the components that make up their computer (monitor, mouse, keyboard, etc.) on a scale of 1-5, 1 being none at all, 2 some, 3 a moderate amount, 4 quite a bit and 5 five being a great deal. One of the teachers or 4.3% had none at all. Three teachers or 13% had some, six teachers or 26% a moderate amount. Seven teachers or 30.4% quite a bit and six teachers or 26% had a great deal. This can be seen in figure 1

Figure 1



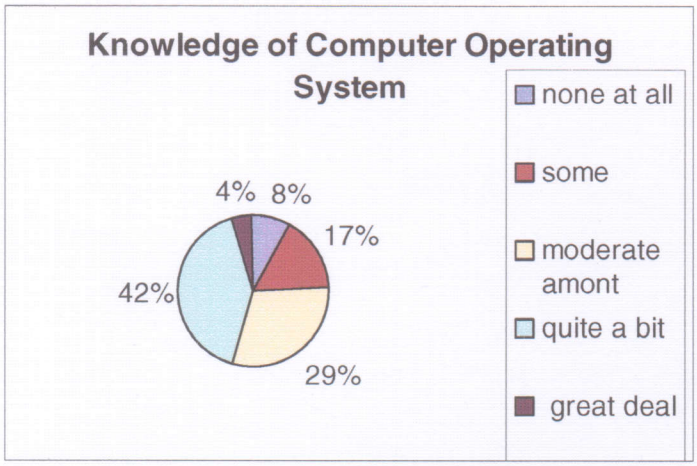
Teachers surveyed taught in grades K-4 and they were asked the following question: if shopping for a computer, would they be comfortable identifying the specifications needed, such as memory, hard drive, size of screen, type of machine? Three teachers or 13% not at all would not feel comfortable shopping for a computer while four teachers or 17.3% somewhat and nine teachers or 39% moderately. Six teachers or 26% feel very good and one teacher or 4.3% would feel completely comfortable shopping for a computer. This is shown on figure 2 below.

Figure 2



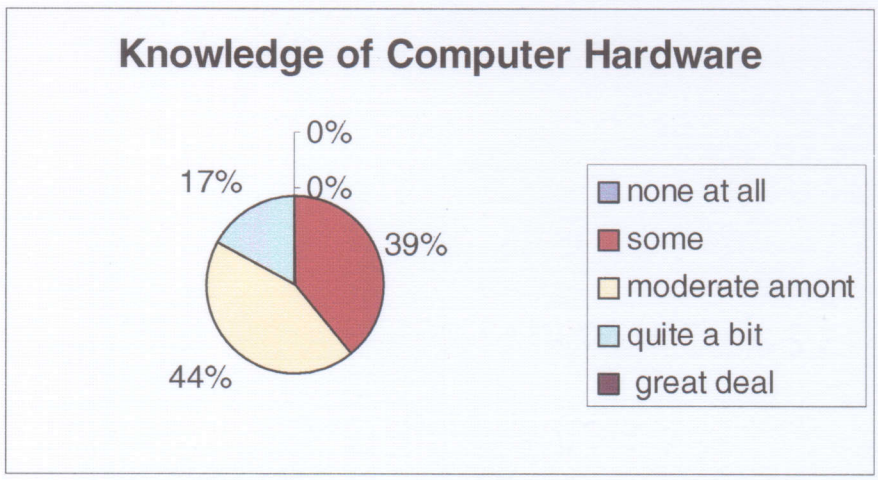
Because of the different computer operating systems and their many functions (e.g. Window 2000, Window XP, Mac Operating Systems) it was important to find out their knowledge of them. Two teachers or 8.6% of the teachers surveyed reported none at all, and four teachers or 17.3% had some knowledge of the different computer operating systems. Seven teachers or 30.4% had a moderate amount of knowledge, ten teachers or 43.9% had quite a bit and one teacher or 4.3% had a great deal. When you see the figure 3 below this becomes clear.

Figure 3



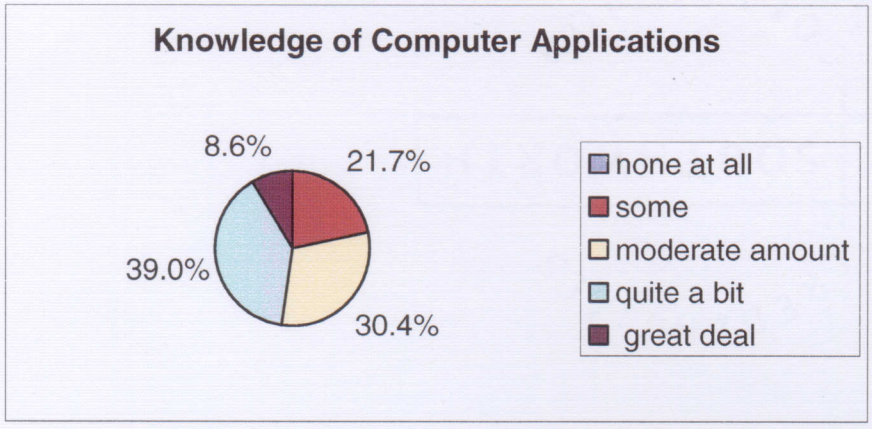
Some computer hardware was already in the school and classroom when most of the teachers arrived at H. B. Wilson School. Teachers were surveyed to find out their knowledge of existing computer hardware (memory, hard drive, size of screen, scanners, etc.) Nine teachers or 39% felt they had some knowledge, ten teachers or 43.9% a moderate amount and 4 teachers or 17.3% had quite a bit. As you can see from the figure 4 below, this makes it clear.

Figure 4



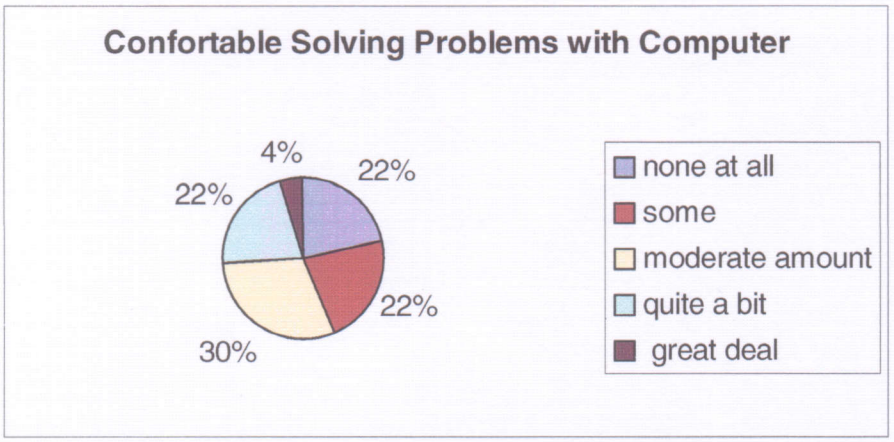
Many computer applications programs approved by the Camden School district and our school (e.g., word processing, spreadsheet, presentations, etc) thus, teachers were surveyed on their knowledge of general computer application programs. Five teachers or 21.7% had some; seven teachers or 30.4% have a moderate amount of knowledge of computer application. Nine teachers or 39% had quite a bit of knowledge of computer applications and two teachers or 8.6% had a great deal of knowledge of computer application programs. See figure 5 below.

Figure 5



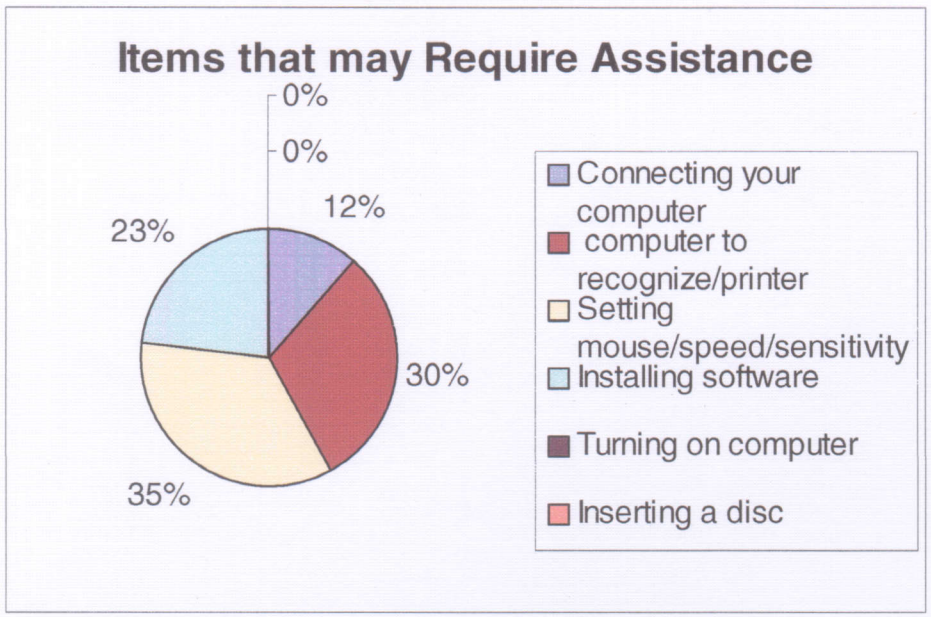
There are at least 5-8 computers in each classroom at H. B. Wilson School. Teachers were surveyed on how comfortable they would be solving problems when the computer was not working. Five teachers or 21.7% were not comfortable at all when the computer was not working. Five teachers or 21.7% felt somewhat comfortable, seven teachers or 30.4% had a moderate amount of comfort with solving problems with the computer when it was not working. Five teachers or 21.7% could solve problems with the computer and one teacher was very comfortable solving problems with the computer that was not working. This is clearly indicated in the chart of figure 6, below.

Figure 6



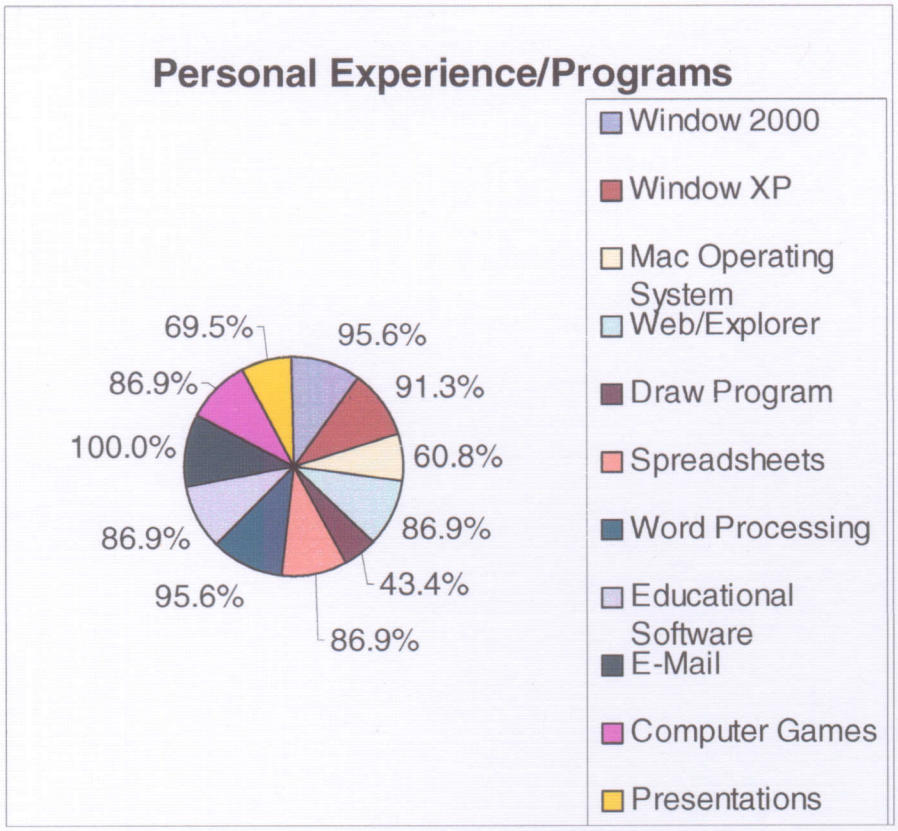
To explore areas that teachers would possibly need assistance in, the survey listed certain tasks that could be a problem for some teachers. Teachers were told to circle any task in which they would need help. Five teachers or 21.7% would need assistance in connecting their computer components (e.g., monitor, keyboard, etc.). Thirteen teachers or 56.5% would need assistance in setting the computer to recognize their printer. Fifteen teachers or 65.2% would need assistance in setting the mouse for speed/sensitivity. Ten teachers or 43.4% would need assistance installing software. Others items on the survey included: turning the computer on, inserting a disc and using the mouse. Also teachers were surveyed as to the importance of knowing how to do these tasks. Nineteen teachers or 78.2% said yes it was important to know how to do all these tasks while five teachers or 21.5% said no it was not important to know how to do all of these tasks. This can be clearly seen in figure 7, below.

Figure 7



Personal computer experience of the teachers with programs is one of the keys to getting computer use in the classroom. The surveyed teachers were asked about their personal experience with different kinds of computer programs. Twenty-two teachers or 95.6% had a personal experience with Windows 2000, twenty-one teachers or 91.3% with Windows XP, fourteen teachers or 60.8% with Mac operating systems. Twenty teachers or 86.9% use the Internet with web/explorer. Ten teachers or 43.4% had a personal experience with a draw program, twenty teachers or 86.9 had experience with spreadsheets, twenty-two teachers or 95.6% with word processing, and twenty teachers or 86.9% used the educational software. Twenty-three teachers or 100% used e-mail, twenty teachers or 86.9% had experience with computer games and sixteen teachers or 69.5% had experience with presentations programs. This can be seen from figure 8, below.

Figure 8



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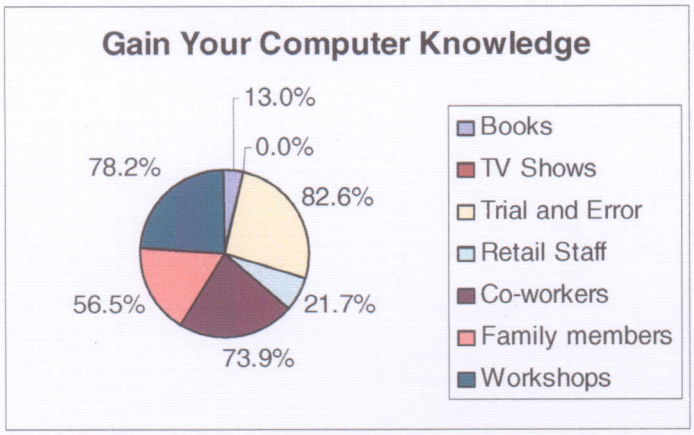
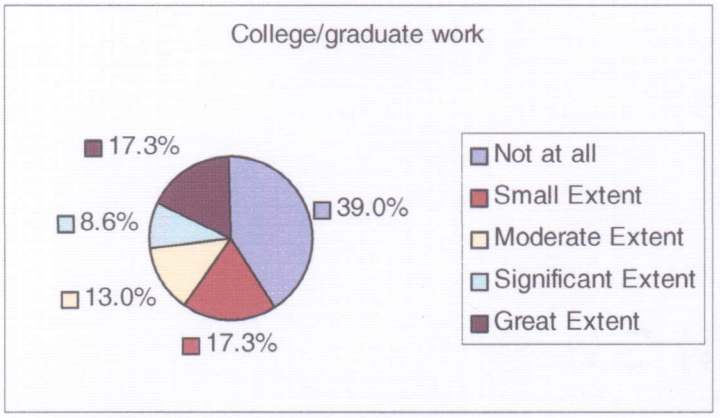
The more computer knowledge a person gets, the more comfortable that person is using computers. We acquire knowledge in many ways. The survey wanted to show how teachers gain this knowledge. Three teachers or 13% gain knowledge from books, nineteen teachers or 82.6% from trial and error with computer and programs. Seventeen teachers or 73.9% gain their computer knowledge from co-workers, thirteen teachers or 56.5% from family members and eighteen teachers or 78.2% gain their computer knowledge from workshops. See figure 9 below

Figure 9



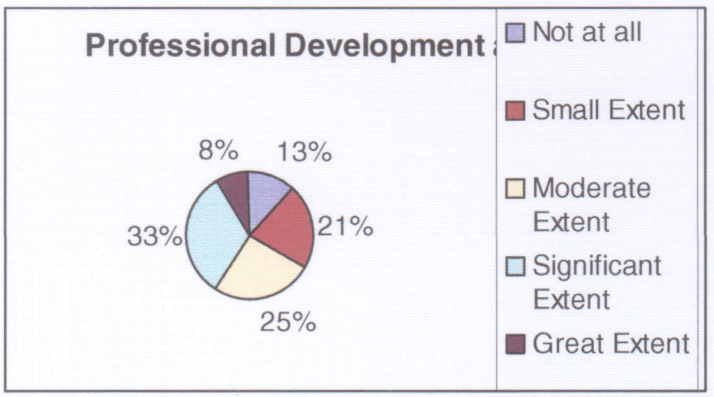
Teachers are prepared to use computers and technology in many ways. Surveyed teachers were asked what personally prepares them to use computers. Listed first on the survey was college/graduate work, nine teachers or 39% said not at all, four teachers or 17.3% small extent, three teachers or 13% felt that college/graduate work had prepared them to a moderate extent. Two teachers or 8.6% felt college/graduate work had prepared them to a significant extent and four teachers or 17.3% to a great extent. This can be seen from figure 10 below.

Figure 10



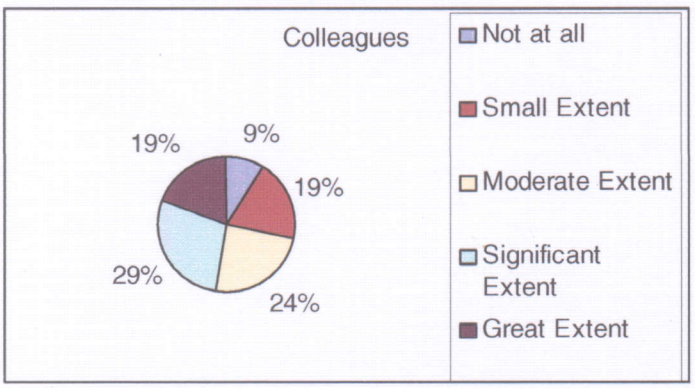
Next was professional development, three teachers or 13% said not at all, five teachers or 21.7% said to a small extent, six teachers or 26% a moderate extent. Eight teachers or 34.7% said professional development prepared them to a significant extent and two teachers or 8.6% a great extent. This can be seen from figure 11 below.

Figure 11



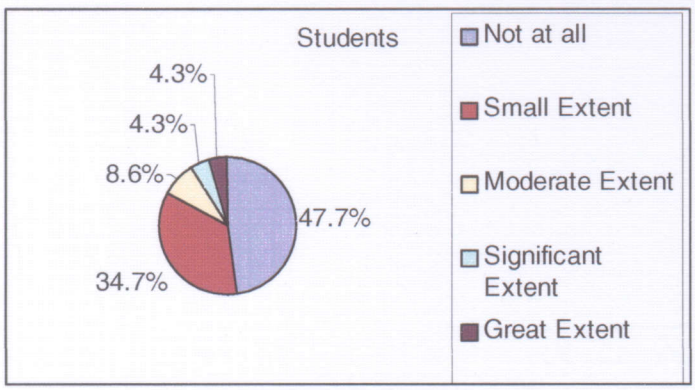
Colleagues was next on the survey, two teachers or 8.6% said colleagues did not all prepare them to use computer, four teachers or 17.3% to a small extent, five teachers or 21.7% a moderate extent, six teachers or 26% a significant extent and four teachers or 17.3% a great extent. This can be seen from figure 12 below.

Figure 12



Students could prepare teachers to use computers. One teacher or 4.3% said students did not prepare them at all, eight teachers or 34.7% students prepared them to a small extent, two teachers or 8.6% a moderate extent, one teacher or 4.3% a significant extent and one teacher or 4.3% said students prepared them a great deal. This can be seen from figure 13 below.

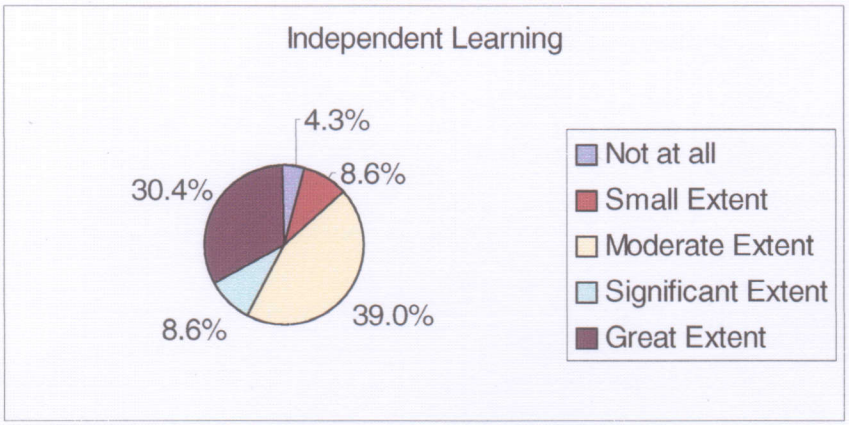
Figure 13



Independent learning was the last item on the survey list. One teacher or 4.3% said independent learning did not prepare them all, two teachers or 8.6% to a small extent, nine teachers or 39% a moderate extent, two teachers or 8.6% a significant extent and

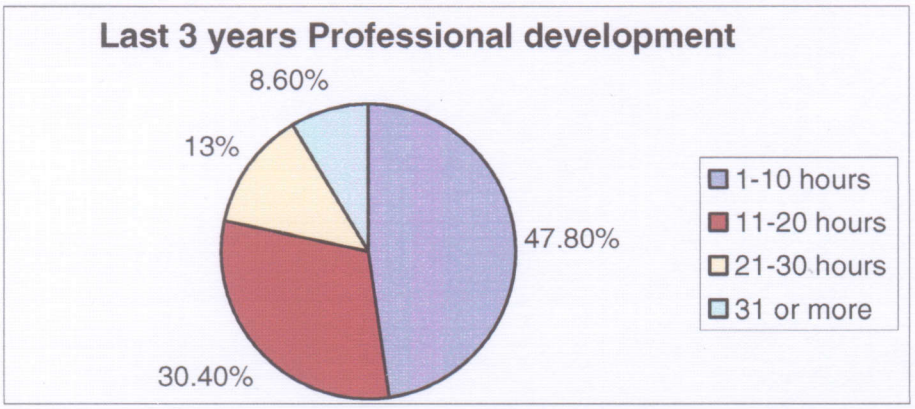
seven teachers or 30.4% said independent learning help prepare them a great extent. This can be seen from figure 14 below.

Figure 14



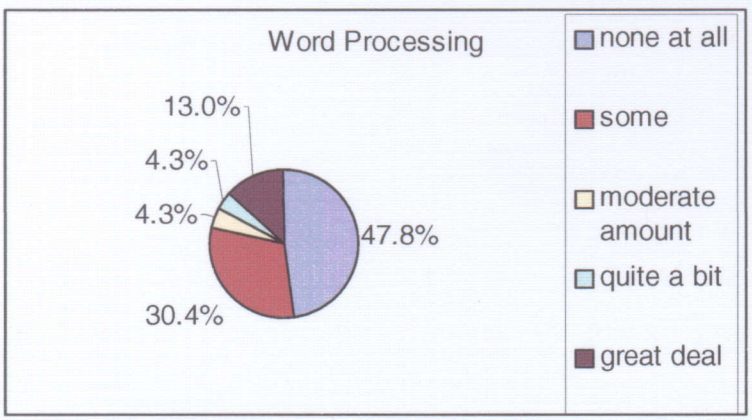
Professional development has always been key to getting teachers prepared to use technology in the classroom. It is thought that the more training a teacher has, the more they will integrate technology into their lessons. The surveyed teachers were asked how much professional development in computers they had had in the last three years. Eleven teachers or 47.8% had 1-10 hours, seven teachers or 30.4% had 11-20 hours, three teachers or 13% had 21-30 hours and two teachers or 8.6% had 31 or more hours. This can be seen from figure 15 below.

Figure 15



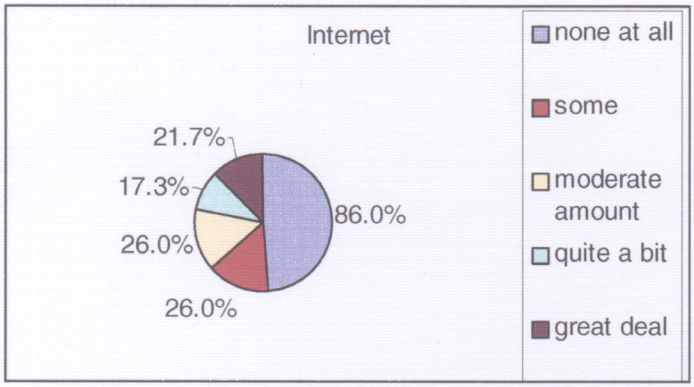
One of the characteristics of frequency of computer use in the classroom by teachers is the activities or applications they use with their students. The survey wanted to show what applications teachers were assigning to students. Word processing was listed and eleven teachers or 47.8% did not use it at all, seven teachers or 30.4% used it some, one teacher or 4.3% quite a bit and three teachers or 13% used it a great deal. This can be seen from figure 16 below.

Figure 16



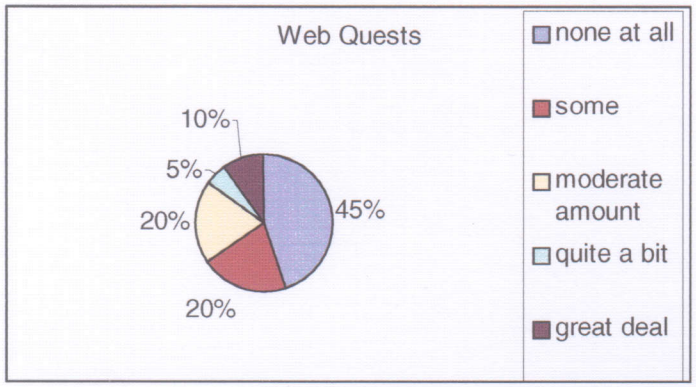
The Internet was also listed on the survey. How teachers were or were not using it is of great concern. Two teachers or 8.6% were not using the internet at all, six teachers or 26% used it some, six teachers or 26% a moderate amount, four teachers or 17.3% quite a bit and five teachers or 21.7% use the internet with their class a great deal of the time. This can be seen in figure 17 below.

Figure 17



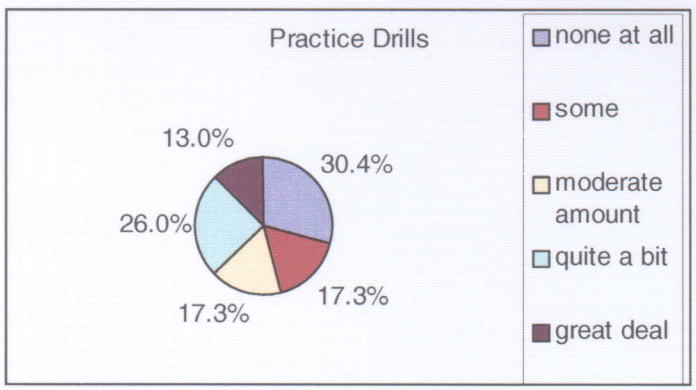
The teachers were also surveyed on the use of Web Quests. Nine teachers or 39% did not use Web Quests at all, four teachers or 17.3% used it some, four teachers or 17% use it 17.3%, only one teacher or 4.3% used it quite a bit and five teachers or 21.7% used Web Quests a great deal. This can be seen in figure 18 below.

Figure 18



Practice drills were next on the list for the surveyed teachers to consider. Seven teachers or 30.4% did not use practice drills at all, four teachers or 17.3% used it some, four other teachers or another 17.3% used it a moderate amount, six teachers or 26% used it quite a bit and three teachers or 13% use practice drills a great deal. This can be seen from figure 19 below.

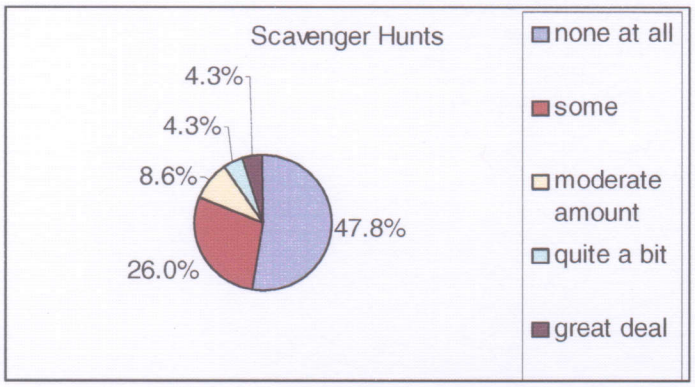
Figure 19



Scavenger Hunts were also on the list for surveyed teacher to access for their classrooms. Eleven teachers or 47.8% did not used scavenger hunts at all, six teachers or 26% used it some, two teachers or 8.6% use it a moderate amount, one teacher or 4.3%

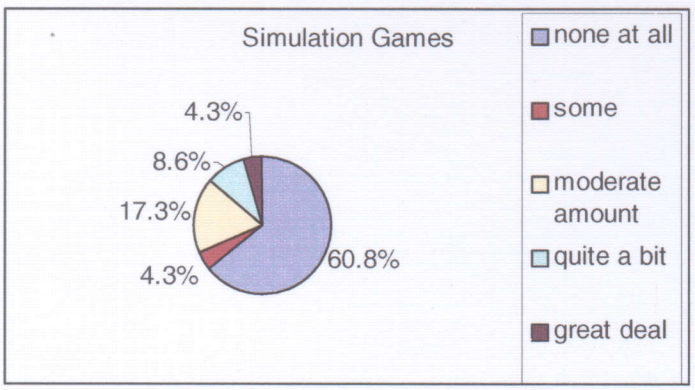
used it quite a bit and one other teacher used scavenger hunts a great deal. This can be seen from figure 20 below.

Figure 20



Simulation Games is also available to the teachers. Fourteen teachers or 60.8% do not use simulation games at all, one teacher or 4.3% used them some, four teachers or 17.3% use them a moderate amount, two teachers or 8.6% use it quite a bit and one teacher or 4.3% uses it a great deal. This can be seen in figure 21 below.

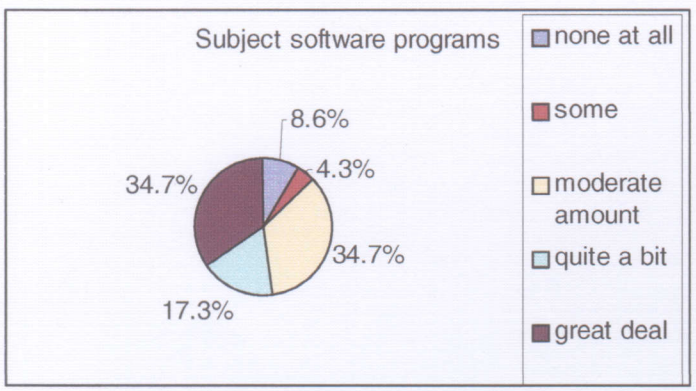
Figure 21



Subject-specific software programs were also included on the list. The surveys wanted to see how the teachers were or were not using subject-specific software programs. Two teachers or 8.6% do not use them at all, one teacher or 4.3% uses them

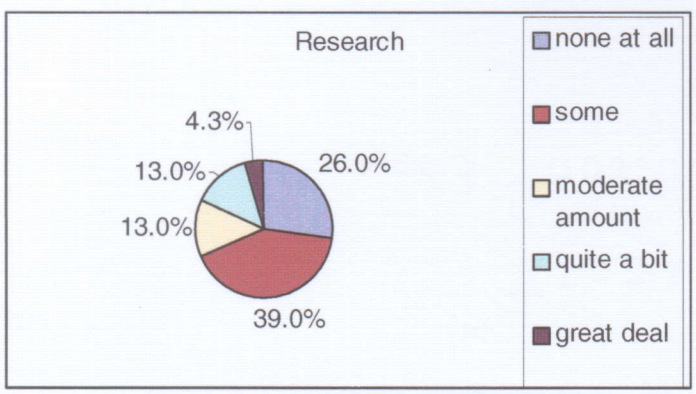
some, eight teachers or 34.7% use them a moderate amount, four teachers or 17.3% use them quite a bit and eight teachers or 34.7% use subject-specific software programs a great deal. This can be seen from figure 22 below.

Figure 22



Research for the students was the last item on the list for the teachers to consider. Six teachers or 26% did not use research at all, nine teachers or 39% used it some, three teachers or 13% use research a moderate amount, three more teachers or 13% use it quite a bit and one teacher or 4.3% uses research a great deal. This can be seen from figure 23 below.

Figure 23



Summary

This chapter analyzed the data collected. The results of the survey that was completed by the 23 subjects were reviewed and presented in graphic form. Due the Camden School district's constant focus on technology, there was a high percentage of teachers who had basic knowledge of computers. About 30.4% of the teachers surveyed felt comfortable with some computer software programs and hardware. Some of the operating systems of the computer were used by a high percentage of teachers. Ninety-five percent of the teachers used Window 2000 and 91.3% were using Windows XP.

Teachers tend to get their computer knowledge from trial and error (82.6%), while78.2% get their computer knowledge from workshops. Professional development helps prepare most teachers to use computers, about 34.7%. Forty-seven percent of teachers surveyed had at least 1-10 hours of professional development in the last three years.

There has been great progress throughout the district over the years with teachers' education and integration of computers in the classroom. Hopefully, this will continue to be implemented in the future.

Chapter 5

Conclusions and Recommendations

Summary of the Problem

Research has shown that some teachers have a high frequency of computer use in their classrooms and others do not. The purpose of this study was to determine if any recognizable characteristics of teachers who have a high frequency of computer use in their classrooms differed from teachers who have a low frequency of computer use in their classrooms.

Summary of the Procedures

A review of literature pertaining to the frequency of computer use of computers by teachers in their classroom was conducted. Following this review, a problem was formulated. The problem that resulted was: Could it be that teachers who have a high frequency of computer use in their classroom have recognizable characteristics other than those teachers who have a low frequency of computer use in their classroom.

A data collection instrument was developed specifically for the purpose of this study. This instrument was a 47-question survey. This survey was distributed to the teachers at H. B. Wilson Elementary School. The surveys were collected and the results were analyzed.

Conclusions and Implications

Using the data from Chapter 4, it was determined that there were many recognizable characteristics that show significant differences between those teacher who have a high frequency of computer use in their classrooms and those who have a low frequency of computer use in their classrooms. The null hypothesis stated: There will be no significant difference in the characteristics and attitudes of teachers who have a high frequency of computer in the classroom than teachers who have low frequency of computer use in the classroom as determined by the Technology Survey prepared by the researcher specifically for this purpose.

In the area of computer knowledge of computers and components, the results showed that 95.7% of the teachers felt comfortable with their knowledge of computer components (monitor, mouse, keyboard, etc). Only 4.3% of teachers had no knowledge at all of the computers components. Teachers who have knowledge of components of computers are more likely to use the computer in their classroom. Personal experience with computers is translated to use in the classroom. Of the teachers who would be shopping for a computer or identifying the specifications such as memory, hard drive, size of screen and type of machine, 87% of the teacher would feel comfortable shopping for one. This would not be a big factor in computer use in the classroom but it adds to the teachers' knowledge. Thirteen percent of the teachers shopping for a computer would not feel comfortable at all. Knowing a computer's operating system is another characteristic that would help determine computer use in the classroom. Ninety-two percent of the

teachers have knowledge of the following computer operating systems: Window 2000, Windows XP and Mac. Eight percent of the surveyed teachers had none at all. All of the teachers or 100% felt this was absolutely necessary. Thirty-nine percent of teachers had some basic knowledge of computers hardware, which included memory, hard drive, and size of screen, keyboard and monitor. Forty-four percent had a moderate amount and 17% had quite a bit of basic knowledge of computer hardware. Having this basic knowledge of computer hardware helps teachers to use computers in the classroom. Teachers felt comfortable with the computer if they were knowledgeable about them. One of the recognizable characteristics of computer use in the classroom is the knowledge teachers about have computer programs. The survey showed that 21.7% of the teachers had some knowledge, 30.4% of the teachers had a moderate amount, surprisingly 39% of the teachers had quite bit, while 8.6% of the teacher had a great deal of knowledge of application programs. This is one of the chief characteristics of teachers who have high computer use in the classroom. So 78% of the teachers have significant knowledge about application programs.

The survey wanted to know the comfort level of teachers who had knowledge of technical problem solving the computers. Because problems with their computer will often surface in the teachers' rooms, and it may take a while before a technician is assigned, teachers need to know how to solve basic problems. Of the teachers surveyed, 78.1% of the teachers felt very comfortable solving problems with computers. This is another characteristic that would be a plus for teachers using computers in their classrooms. Teachers listed items that they would need assistance with while using computers in the classrooms. Fifty-six percent of the teachers would need assistance

setting a computer to recognize their printer. Sixty-five percent of the teachers would assistance setting the mouse for speed/sensitivity, and 43.4 of the teachers need help installing software. All schools have a tech person in the building therefore this would not be a major factor in computer use in the classroom for teachers. Personal experience or exposure to computer programs was also surveyed. Ninety-three percent of the teachers had personal experience with Window 2000 and Window XP. Eighty-six percent of the teachers used the web/Explorer and 100% had experience with E-mail. Ninety-five percent had experience with word processing, 86.9% with spreadsheets and educational software, and only 43.4% had experience with drawing programs. Also, 69.5% of the teachers had experience with presentation software. This is another key recognizable characteristic of teachers who have high computer use in the classroom.

How are teachers gaining their computer knowledge? According to the survey, 82.6% of the teachers from trial and error, 73.9% from co-workers, 78.2% for workshops, and surprisingly 73.9% of teachers gain their knowledge from co-workers. A small percent gained their knowledge from books and retail staff. None of the teachers gained knowledge from TV shows. This indicates that teachers are learning on their own, learning from co-workers and workshops. This makes for a healthy environment for computer use in the teachers classroom.

The survey wanted to know what has prepared teachers to use computers in their classroom? Teachers listed college/graduate work, 38.9% feel that this prepared them to use computers. Six-five percent of the teachers felt professional development helped them to use computers in the classroom, 74% felt colleagues helped, 95% felt the students aide them and 95% felt independent learning helped them prepare to use

computers in the classroom. Teachers are better prepared to use computers in the classroom than ever before.

Professional development is another key to teachers using computers in their classrooms. Teachers were asked how much professional development was completed in the last three years. Forty-eight percent of the teachers have 1-10 hours, 30.4% with 11-20 hours, 13% with 21-30 hours and 8.6% of the teachers had 31 or more completed hours of professional development. Professional development is a key recognizable characteristic of teachers using computers in the classroom.

Another key recognizable characteristic of teachers who have high frequency computer use in the classroom is applications used by the teachers and the type they assign to their students. Fifty-two percent of the teachers used word processing in their classroom, 91.4% of the teachers used the Internet, 55% use Web Quests, and 69.6% used the Practice drills in their classroom. Fifty-two percent of the teachers used Scavenger hunts, while 39.2% only used Simulation games. Subject-specific software was used by 91.4% of the teachers. This may be due to a district wide program used by all classroom teachers. Even though H. B. Wilson School is K-4, research was used by 74% of the teachers in their classrooms. The teachers used some of the programs more than others because this is an elementary school.

Computers have become commonplace in elementary schools. Though the change started slowly, it has accelerated at an alarming rate. It is alarming because most educators have not been instructed in the use and applications of this challenging technology.

Though many of the colleges and universities in New Jersey require students in Education Programs to take a course in computer use and technology, the state of New Jersey requires newly certified educators to have only a minimum level of competency using computer technology. Perhaps in the coming years, when the additional hours of instructions have been adopted for teachers, the level of teachers having formal instruction will increase.

Recommendations for Future Study

As with all research there were limitations to this study. Overall, this was a small study. Replication at other elementary schools would increase the available data. Also noted, as limitations were the affect that administration may have on the staff and the overall availability of computers in individual classrooms.

Suggestions for further studies may include continuing to monitor frequency of computer use as it relates to the age and years of experience of the teachers. It may be helpful to follow this for a long-term study to determine if familiarity with computers may account for an increase in computer use in classrooms over time.

Additional questions could be asked regarding the types of professional development that teachers have had.

Also, further questions regarding why teachers felt well prepared to use computers for personal use, but not for classroom integration may offer some insight into how we can adapt training that may help teachers to make the transfer from personal use

to classroom use. Understanding their beliefs about integrating computer may be beneficial.

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Appendix

TECHNOLOGY SURVEY

This survey is being administered as part of graduate research project at Rowan University. While your participation is voluntary and you are not required to answer any of the questions herein, your cooperation and participation are important to the success of the project and are greatly appreciated. If you choose to participate, please understand that all responses are strictly confidential and no personally identifiable information is being requested.

Grade_____

This survey is being used to investigate some of the characteristics of teachers that are integrating technology in the classroom. Please indicate which response best captures your personal experience.

The first set of questions deals with you existing knowledge about computer. Please circle the most appropriate number.

1. a) How much knowledge do you feel you have about the components that make up your computer (monitor, mouse, keyboard, etc)?

1	2	3	4	5
none at all	some	a moderate amount	quite a bit	a great deal

b) Is this absolutely necessary? _____Yes _____No

2. a) If you were shopping for a computer, would you be comfortable identifying The specifications you would need for: memory, hard drive, size of screen,, type of machine?

1	2	3	4	5
not at all	somewhat	moderately	very	completely

b) Is this absolutely necessary? _____Yes _____No

3. a) How much knowledge do you feel you have about computer operating system (e.g. Window 2000, Window XP, Mac Operating System)?

1	2	3	4	5
none at all	some	a moderate amount	quite a bit	a great deal

b) Is this absolutely necessary? _____Yes _____No

4. a) How much knowledge do you feel you have about computer hardware (e.g. memory, hard dive, size of screen, etc.)?

1	2	3	4	5
none at all	some	a moderate amount	quite a bit	a great deal

b) Is this absolutely necessary? _____Yes _____No

5. a) How much knowledge do you have about computer application programs (e.g., word processing, spreadsheet, presentations, etc)?

1	2	3	4	5
none at all	some	a moderate amount	quite a bit	a great deal

b) Is this absolutely necessary? _____Yes _____No

6. a) How comfortable do you feel about problem solving when your computer Is not working?

1	2	3	4	5
none at all	some	a moderate amount	quite a bit	a great deal

b) Is this absolutely necessary? _____Yes _____No

7. a) For each of the items below, circle those for which you would require Assistance:

a. Connecting your computer components (e.g., monitor, keyboard)
b. Turning on the computer
c. inserting a disc
d. inserting a CD-ROM
e. using a mouse
f. setting the computer to recognize your printer
g. setting the mouse for speed/sensitivity
h. installing software

b) Is this absolutely necessary? _____Yes _____No

8. a) For which of the following programs have you had any personal Experience or exposure (circle):

a. Window 2000
b. Window XP
c. Mac operating system
d. web/Explorer
e. draw program
f. spreadsheets
g. word processing
h. educational software
I. e-mail
j. computer games
k. presentations

b) Is this absolutely necessary? _____Yes _____No

9. a) How did you gain your computer knowledge? (please circle as many as Apply)

a. books
b. TV shows
c. trial and error
e retail staff
e. co-workers
f. family members
g. workshops

b) Is this absolutely necessary? _____Yes _____No

10. To what extent do you believe the following have prepared you to use computers?

	Not at all	Small Extent	Moderate Extent	Significant Extent	Great Extent
College/graduate work	1	2	3	4	5
Professional Dev activities	1	2	3	4	5
Colleagues	1	2	3	4	5
Students	1	2	3	4	5
Independent learning	1	2	3	4	5

11. In the last 3 years how many hours of professional development (not college) in the use of computers have you had?

_____1-10 hours _____11-20 hours _____21-30 hours _____31 or more

12. For each activity or application listed below, please indicate how often you use computers with your students or assign to students during class time.

1 none at all	**2 some**	**3 a moderate amount**	**4 quite a bit**	**5 a great deal**
Word Processing (Word etc.)	1	2	3	4	5
Internet	1	2	3	4	5
Web Quests	1	2	3	4	5
Practice Drills	1	2	3	4	5
Scavenger Hunts	1	2	3	4	5
Simulation Games (SimCity etc.)	1	2	3	4	5
Subject-specific software programs	1	2	3	4	5
Research	1	2	3	4	5