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Correlating Technology Surveys and Third- and Fifth-Grade Proficiency Levels in Math and
Reading Throughout Tennessee

A dissertation

presented to

the faculty of the Department of Educational Leadership and Policy Analysis

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Doctor of Education

by

Gary L. Lilly

December 2004

Dr. Russell West, Chair

Dr. Louise MacKay

Dr. Elizabeth Ralston

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Keywords: Educational Technology, E-TOTE, Elementary, Proficiency, EdTech

ABSTRACT

Correlating Technology Surveys and Third- and Fifth-Grade Proficiency Levels in Math and Reading Throughout Tennessee

by

Gary L. Lilly

This study used two different sets of data collected through two distinct means during the 2002-2003 school year. To fulfill the federal accountability requirements related to the distribution of monies known as EdTech (2002), the Tennessee State Department of Education required every school within districts that accepted the formula EdTech funds to complete an online survey called the EdTech Tennessee Online Technology Evaluation or E-TOTE. The E-TOTE survey collected information on a variety of topics related to educational technology including questions about teaching and learning, educators' preparation and development, infrastructure, and equipment counts. The other set of data came from a new criterion-referenced portion of the otherwise norm-referenced state-mandated standardized TCAP test given to third and fifth graders to also meet *No Child Left Behind* accountability requirements for the subjects of math and reading.

Evaluations of E-TOTE survey responses revealed that most faculty members at the 1,066 schools examined in this study reported they did not feel comfortable integrating technology to the extent necessary to create fundamental changes to traditional teacher-centered pedagogies. Related to this realization could be that few schools or districts have implemented high-quality communities of learning designed to elevate teachers' levels of understanding to a sufficiently high degree as to help them feel qualified to integrate technology. Furthermore, even though the

majority of the networking infrastructure within schools examined in this study seemed to be relatively robust, many reported high student-to-computer ratios often combined with long replacement cycles.

Multistep hierarchical regression models were used to account for the variance in the percentage of students in third and fifth grades attaining the advanced proficiency levels in math and reading. The models accounted for a number of nontechnological school characteristics such as school population, number of minority students, number of economically disadvantaged students, and per-pupil expenditure before examining the role of the aforementioned E-TOTE topics in the final step of the regression model. No strong relationships were found to exist between the technological characteristics and the advanced proficiency levels of third or fifth graders in math or reading.

DEDICATION

I dedicate this work to my wife and children from whom I have stolen much time.

I also dedicate it to my parents who have never wavered in their insistence that I could accomplish anything, despite numerous signs to the contrary.

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I would like to acknowledge the support and assistance of my graduate committee members:

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Dr. Louise MacKay

Dr. Elizabeth Ralston

Dr. Jasmine Renner

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CHAPTER 1

INTRODUCTION TO THE STUDY

The challenge facing America's schools is the empowerment of all children to function effectively in their future, a future marked increasingly with change, information growth, and evolving technologies. Technology is a powerful tool with enormous potential for paving high-speed highways from outdated educational systems to systems capable of providing learning opportunities for all, to better serve the needs of 21st century work, communications, learning, and life. (International Society for Technology in Education, 2000, p. xi)

The words and sentiment echoed above by the International Society for Technology in Education have been supported by the vast majority of policy makers, parents, and educators for well over a decade as is evident by the more than \$40 billion dollars of local, state, and federal funds that have been committed to purchasing computers and the infrastructure to get schools connected to the Internet (Benton Foundation, 2003). Recommendations have been made to educators and policymakers to use technology in ways that will create powerful new learning opportunities by allowing students and teachers to work on authentic problems, teach students to use data to control their learning, build diverse learning communities, and interact with experts and stakeholders (Jones, Nowakowski, Rasmussen, & Valdez, 1995). Through the passage of the *No Child Left Behind Act* that was signed into law on January 8, 2002, as the reauthorization of the *Elementary and Secondary Education Act (ESEA)*, states began receiving money from the Title II block grant (Part D, Subpart 1) commonly known as EdTech. The overview from this section of the act stated that the grant program should "...support the integration of educational technology into classrooms to improve teaching and learning" (U.S. Department of Education, 2002, p. 49). Paige (2002), the U.S. Secretary of Education, wrote in a welcome letter on the government's website that, "The new law will give states more flexibility on how they spend

their education dollars. In return, it requires them to set standards for student achievement, and hold students, teachers, and other educators accountable for results” (n. p.).

In 2002, the state of Tennessee distributed half of the EdTech funding it received to Local Education Agencies (LEAs) based on a formula related to Title I shares. The other half of the money was awarded through a competitive process. To fulfill the accountability requirements that accompany the receipt of the EdTech funds, the Tennessee Department of Education required all schools within any district accepting those funds to complete a survey called the EdTech Tennessee Online Technology Evaluation System (E-TOTE). Jerry Bates, the Director of Applied School Technology for the state, announced the E-TOTE program in a memorandum to directors of schools stating:

We anticipate the statewide reporting from E-TOTE will give us a far more reliable picture of the state of technology across Tennessee. We believe this is essential if we are to undertake any strategic planning with vision for the use of technology in our schools. (J. Bates, personal communication, November 22, 2002)

The intent of the *No Child Left Behind* Act is to help schools and school systems show greater percentages of students proficient in the subjects of math, reading, and language arts. The ultimate goal is for all students to be proficient in those subjects by 2013-2014. To that end, Tennessee merged its accountability system with the provisions of *No Child Left Behind*. The result was the addition of two new categories one of which was a criterion-referenced test showing math and reading proficiency of third and fifth graders (Tennessee Department of Education, 2003a).

This study sought to examine how technology use in Tennessee, as reported through the E-TOTE survey instrument, correlated to the proficiency levels of third and fifth graders in the subjects of math and reading. The results from the study could provide some insights as educators and policymakers come to terms with the implementation and potential impact of educational technology within Tennessee.

Statement of the Problem

The E-TOTE survey contained a section of questions related to the integration of technology within classrooms referred to as Teaching and Learning. It also contained questions designed to assess the areas of educator preparation and development, infrastructure for technology, and equipment counts. The purpose of this study was to examine the relationship between those E-TOTE sections and the proficiency levels of third and fifth graders in the subjects of math and reading. The study factored in the number of students attending the school, the number of minority students, the number of economically disadvantaged children, and the per-pupil expenditure reported by the district.

Research Questions

The following research questions guided this study:

1. To what extent were educators integrating technology into instruction and did this usage seem to be related to the socioeconomic status of the school's population or the district's per-pupil expenditure?
2. How did educators perceive their levels of professional development in instructional technology and did this seem to be related to the socioeconomic status of the school's population or district's per-pupil expenditure?
3. What was the infrastructure for technology and did this seem to be related to the socioeconomic status of the school's population or district's per-pupil expenditure?
4. What relationships, if any, existed between the technological characteristics of Tennessee schools and the advanced proficiency levels of third and fifth graders in math and reading?

Significance of the Study

The fact that the *No Child Left Behind* Act included money for educational technology underscored the hope of policymakers and many others who assert that technology can play a significant role in creating positive educational opportunities and reform. According to the EdTech (2002) website, the EdTech program was appropriated \$700,500,000 in 2002 and \$695,946,750 in 2003 (U.S. Department of Education, 2003). It is important to gather data to explain the value of such expenditures.

This study examined how educational technology correlated to proficiency levels. Additionally, the study investigated how different aspects of educational technology affected outcomes. As teachers and administrators strive to reach ever-increasing average yearly progress (AYP) requirements imposed by the new law, knowing the best ways of implementing instructional technology could certainly prove to be useful. Classroom teachers need to know the potential for increasing proficiency levels that technology integration and professional development may hold. Administrators need to understand the potential for infrastructure and hardware to make a difference. Through the examination of these issues, this study might be a vehicle for pedagogical change. It might also help direct policy at the local and state levels to redirect resources in a manner that would most likely have the biggest payoff in proficiency gains.

This research helped address shortcomings and seeming conflicts in existing literature. For example, observations made by Cuban (2001) lead him to conclude, "In the schools we studied, we found no clear and substantial evidence of students increasing their academic achievement as a result of using information technologies" (p. 133). Still, other studies do show gains such as those measured through the alignment of curriculum standards, software, teaching instruction, and tests in a West Virginia study that examined SAT-9 scores for 950 fifth graders in 18 schools (Mann, Shakeshaft, Becker, & Kottkamp, 1999). Surprisingly, although a plethora of literature exists, a scant amount is recent enough or of sufficient quality to help frame

questions related to the effectiveness of instructional technology. One reason for this lack is the speed by which technological changes tend to happen. Kirkpatrick and Cuban (1998) made such a point by stating, “Hardware and software changes occur far faster than researchers can study them. Changes in computer speed, memory, and programs make earlier studies virtually obsolete” (26). A meta-analysis on the effects of teaching and learning with technology on student outcomes also established a dearth of sound research:

First, there are few quantitative studies published in the last five years that include relevant data to permit a meta-analysis and calculation of effect sizes. Scientific journals that use independent peer review in deciding what research merits publication are generally considered to be the high standard of research, yet much of the work in the field of teaching and learning with technology does not meet that standard. The lack of quality, refereed quantitative studies points to a serious problem of research in the field. (Waxman, Connell, & Gray, 2002, p. 12)

An examination of this study should add to the discussion surrounding educational technology in Tennessee and frame other questions for future research. I hope that the information obtained through this study will help districts in other states as they struggle with the most effective way to realize the best use of instructional technology.

Definitions

The following are definitions of terms used in this study:

1. *CAI*: Computer-Assisted Instruction; the teacher’s role is de-emphasized (Kirkpatrick & Cuban, 1998).
2. *CEI*: Computer-Enhanced Instruction; the teacher’s role is essential in the learning process (Kirkpatrick & Cuban).
3. *CMI*: Computer-Managed Instruction; the teacher’s role is de-emphasized (Kirkpatrick & Cuban).

4. *E-TOTE*: EdTech Tennessee Online Technology Evaluation System (Ed Tech, 2002).
5. *High-Capacity Computer*: Defined by E-TOTE survey as “Pentium III (PCs) or Macintosh G4 or higher” (EdTech, p. 10).
6. *Integrated Learning System (ILS)*: “Networked comprehensive basic skills software from a single vendor” (Becker, 1992, p. 1).
7. *Low-Capacity Computer*: Defined by E-TOTE survey as “thin client, Pentium, 486 processors or 68040 processors (Macintosh, Centris, Quadra, LC 475, LC 575, LC 580) that are still in use” (EdTech, p. 10).
8. *Mid-Capacity Computer*: Defined by E-TOTE survey as “Pentium II or Macintosh G3. (EdTech, p. 10).
9. *Per-pupil expenditure*: “Total current operating expenditures on a per pupil basis. Some examples are instructional materials, maintenance, and transportation” (Tennessee Department of Education, 2003b).
10. *Proficiency*: Score reported as a percentage referring to questions on criterion-referenced portion of *Terra Nova* standardized test rating students' mastery of curriculum as below, at, or above expectations .

Delimitations and Limitations

This study was delimited by a number of factors. The population studied included all schools in the state of Tennessee that received EdTech formula grants and were therefore required to complete an E-TOTE survey. Furthermore, only grades three and five were examined because those were the only grades showing reported proficiency scores for math and reading. Schools without third or fifth grades were excluded from the study.

The results of this study can be generalized only for the population being studied. In addition, the study was limited by the accuracy and honesty of answers received on the E-TOTE surveys by respondents.

Overview of the Study

This study is divided into five chapters. Chapter 1 provides an introduction to the study as well as a statement of the problem, pertinent research questions, significance of the study, definitions of terms, and delimitations and limitations. Chapter 2 presents a review of literature related to the issues that were addressed in the study. Chapter 3 focuses on the research methodology and design. The results are discussed in Chapter 4. Finally, the summary, conclusions, and recommendations are highlighted in Chapter 5.

CHAPTER 2

REVIEW OF RELATED LITERATURE

There are five sections in this review of related literature. Each section gives the reader a deeper understanding of how educational technology has come to be an important topic for educators, politicians, vendors, tax payers, and, ultimately, students. The first section highlights some of the factors that have driven the push to get computers into schools and to get those computers networked. The second section examines some research suggesting that the investment in educational technology was not making much difference in the education of students. Of course, one wonders why an investment such as this might fail to produce glowing results. Section three addresses several factors in the current literature that might help explain why educational technology initiatives seem to fall short of the grand hopes many have had for them.

That is not to say that all of the current literature is negative concerning the extent to which educational technology can improve students' achievement. Quite the contrary, many research articles suggested that educational technology, when used correctly, could help students realize greater achievement. Section four delves into some of the specifics of these studies. The fifth section addresses some of the findings and recommendations of past researchers who have noted limitations in their studies and suggested further inquiries into the implementation and effectiveness of educational technology. Finally, this chapter ends with a summary of the related literature.

Although a plethora of articles, studies, and other literature exists on the topic of educational technology, many of these works are dated because they related to the state of

educational technology 10, 15, or even 20 years in the past. Attempts were made to obtain research that was more recent for the purpose of this review. Some notable exceptions include the review of works by well-known and often-cited researchers whose older works continue to be used as a basis for shaping practice and policy.

The Push to Plug-in

“We are convinced that technology, if applied thoughtfully and well-integrated into a curriculum can be utilized as a helpful tool to assist student learning, provide access to valuable information, and ensure a competitive edge for our workforce” (Archer & Walsh, 1996, p. 13). The preceding statement was issued at a 1996 Educational Summit involving captains from a range of interests, including governors, corporate leaders, federal officials, and some educators. Cuban (2001), a professor of education at Stanford University, maintained that the lobbying efforts of these different groups had been very successful in generating the funding and motivation to endow schools with high-tech equipment and infrastructure. He cited programs such as the authorization of E-Rate, the universal phone service subsidy that discounts telecommunication costs to schools with high percentages of low-income students. Cuban claimed that the groups promoting increased access to technology in classrooms based their desires on interlocking assumptions:

In seeking to achieve three divergent purposes, techno-promoters across the board assumed that increased availability in the classroom would lead to increased use. Increased use, they further assumed, would then lead to efficient teaching and better learning which, in turn, would yield able graduates who can compete in the workplace. These graduates would give American employers that critical edge necessary to stay ahead in the ever-changing global economy. (p. 18)

Many desiring to reform and restructure modern schooling have embraced the idea that technology has the power to transform schools. These reforms often alluded to the potential of

technology to support student-centered teaching and learning environments. Technology was also seen as a means to address learning in ways removed from traditional lecture through the use of multimedia (Bozeman & Baumbach, 1995). Sometimes referred to as digital learning, the hope of protech reforms is that the integration of technology, connectivity, content, and people will create opportunities for productive and engaging learning that will build skills students need (CEO Forum, 2000).

The effectiveness of efforts to infuse technology into schools can be easily measured by the size of expenditures spent for that purpose. According to a report by the Benton Foundation (2003), "In the past decade, the federal, state, and local governments have invested over \$40 billion to put computers in schools and connect classrooms to the Internet" (p. 7). As stated by Murray (2003), a report issued by Quality Education Data on September 16, 2003, estimated that "schools will spend \$5.8 billion on instructional technology this year alone" (p. 1). Murray added, "The *No Child Left Behind* Act is thought to be spurring some of the major expenditures this year as districts look toward technology to meet the academic and reporting requirements in the act" (p. 1).

Technology played a central role in some educational institutions such as the "virtual high schools" in 16 states. Legislators anticipated that the Florida Virtual School could help shrink class sizes in other districts and still provide a quality education. They have constructed a policy that proposes to give the school per-pupil funding based on full-time equivalent students who pass the online courses (Hendrie, 2003).

Increasingly, the reference to computers in schools seems to imply a connection to the Internet. A report issued by the U.S. Department of Commerce (2002) examined the ways in which Americans' use of the Internet is growing. The report asserted:

Children and young adults under 25 are significant users of new information technologies. By the age of 10, young people are more likely to use the Internet than adults at any age beyond 25. The high rate of use among children and young adults is

reflected in higher rates of Internet connectivity within family households with children as well as in high use rates among these age groups both at home and outside the home. (p. 42)

The bulk of the “outside home” use of the Internet is at schools. A report published by the U.S. Department of Commerce (2002) illustrated computer use by age and location. It was determined that 25.76% of children five to nine years old used computers only at school whereas 48.2% of children in that age-range used computers at school and home. For young people in the 10- to 13-year-old range, 24.66% used computers only at school whereas 59.9% used computers at school and home. The report also disseminated data about the major activities children engaged in while online. Playing games was the primary use of computers in the 5- to 9 year-old range, with 66.4% of children in this group doing so. Only 46.9% of children in this range reported using the computer for schoolwork. The percentages were quite different in the 10- to 13-year-old range. A reported 76.6% young people in this range used the computer for doing schoolwork. A smaller number of children (64.7%) in this range used the computer for playing games (U.S. Department of Commerce).

A report on children’s Internet use from the Corporation for Public Broadcasting (2003) highlighted some interesting statistics about the use of Internet within schools. The report indicated that 69% of students aged 6 to 17 who go online do so within school computer labs. Just 29% access the Internet from one classroom. Only 23% go online in multiple classrooms. On average, 43% access the Internet from the library or media center; this may point to the Internet’s role as a research tool rather than curricular tool (Corporation for Public Broadcasting).

Questioning the Value of Educational Technology

Though the push to get technology into schools has been very successful, there are many who question the value of such investments. In his book, *Oversold & Underused*, Cuban (2001)

made the claim that even after two decades of initiatives designed to provide teachers and students more access to technology, classroom use of those technologies is still uneven and infrequent. While describing a case study in which he interviewed 21 teachers, Cuban said 13 claimed that information technologies had changed their teaching. Many of the 13 said that technology had changed the way they prepared to teach as well as being another tool for teaching. Only four claimed that technology had created fundamental changes in their pedagogy. Largely though, traditional teacher-centered lectures were still the norm. After shadowing students and teachers, Cuban reported:

We saw what classroom researchers have seen for decades. All but a few of the 35 different teachers (in both schools) used a familiar repertoire of instructional approaches. These routinely lectured, orchestrated a group discussion, reviewed homework, worked on assignments, and occasionally used overhead projectors and videos. From surveying teachers and shadowing students we found that in some classes students gave reports, worked in small groups, or, in the media center, completed projects. (p. 95)

If the majority of teachers are failing to appropriately use the technology that is provided to them, it makes sense that simply increasing the number of available computers will do little to affect achievement. In fact, that is essentially what Alspaugh (1999) concluded after doing a study to determine the relationship between the number of students per computer and various educational outcomes including the achievement of sixth graders in reading/language arts, mathematics, science, and social studies. In the 1999 study, Alspaugh matched districts into four comparison groups of students per computer, which included “(a) less than or equal to 4, (b) 5 to 7, (c) 8 to 10, and (d) more than 10.” Alspaugh concluded that the level of access to computers did not appear to be a factor associated with differences in the achievement of sixth graders. He further noted that his findings were consistent with a 1991 meta-analysis by A. W. Ryan and published in the *Educational Administration Quarterly* (Alspaugh).

Even among organizations devoted to helping educators meet educational goals through the effective use of technology, many conceded that educational technologies have yet to yield their potential in most classrooms. Between January and February 2001, NetDay, a nonprofit organization, conducted a national survey of 600 public and private school teachers stratified geographically based on the proportion of teachers in each state. The findings from the survey showed that even though teachers valued technology as a research tool and seemed to be comfortable using computers and the Internet, they were not using it within instruction. The majority of teachers within all the demographic groups of gender, region, age, and race deemed that the Internet was not integrated into their classrooms. On the survey, 67% of the respondents said that “The Internet is a good resource and moderately helpful, but hasn’t changed the way I teach” (NetDay, 2001).

Some question the value of technology in schools because they maintain that there has not been an adequate number of high quality nonbiased studies to draw solid conclusions. Oppenheimer (1997) cited several studies that advocates of educational technology have used to advance their cause. Yet, he stated that these studies offered anything but conclusive evidence because of a lack of scientific controls:

The circumstances are artificial and not easily repeated, results aren’t statistically reliable, or, most frequently, the studies do not control for other influences, such as differences between teaching methods. This last factor is critical, because computerized learning inevitably forces teachers to adjust their style—only sometimes for the better.
(n. p.)

Kirkpatrick and Cuban (1998) made the point that a variety of factors makes it difficult for researchers to assess the value of computers in the classroom. Research on the topic often does not have a clear focus. For example, some studies examine students' scores, while others measure effectiveness in terms of the learning pace or motivation of the students. Secondly, most studies have varied methodologies. Some samples had variations in terms of students'

grade levels, socioeconomic status, and aptitudes. Finally, Kirkpatrick and Cuban, like Oppenheimer (1997), pointed out that few studies take into account the teacher's role in classrooms with computers.

According to Waxman et al. (2002), the meta-analysis commissioned by the North Central Regional Educational Laboratory also raised concerns over the lack of sound research. The report highlighted three issues related to current research:

First, there were few quantitative studies published in the last five years that included relevant data to permit a meta-analysis and calculation of effect sizes. Second, few studies used a randomized, experimental design. A final concern regarding the quality of research in the field pertains to the lack of details that were included in many of the published articles included in this meta-analysis. (p. 12)

Factors Associated With the Unrealized Potential of Educational Technologies

Merely purchasing technology resources has not – and could not have – changed the character of education. Instead, looking at the national landscape, we see individual districts where technology investments have been paired with other key elements like strong district leadership, a defined educational vision with technology serving that vision, and thoughtful professional development to yield observable effects on student learning. We also see many districts that have not brought together all these elements; in these districts, the effects of technology investments are hard to locate. (Benton Foundation, 2003, p. 27)

As the quotation above suggests, if educational technology is not being implemented in such a way that creates a better learning environment for children, then perhaps some common factors are inhibiting such implementation. In fact, research did address several contributing factors that could have stifled the potential impact of using educational technologies.

Interestingly, the human factor seems to determine the success or failure of integrating technology into instruction. This conundrum has been expressed by referring to teachers as both the problem and the solution. In one sense, many CAI, CMI, and ILS computer applications are implemented because it is considered that the computer can better deliver drills based on individual differences than a teacher can. However, with more open-ended CEI applications, the teachers play a far greater role in how the technology is used, thereby affecting the outcomes for the students (Kirkpatrick & Cuban, 1998).

If teachers are not using technology to its full potential, then part of the reason could stem from a general lack of training. As reported by Doering, Hughes, and Huffman (2003), in 2000, the national educational technology plan published by the U.S. Department of Education reported that fewer than half of the teacher-preparation programs required students to use technology when designing or delivering instruction. Furthermore, these survey results showed that the majority of education graduates reported that they did not feel well prepared to integrate technology into instruction. It was also noted that many preservice, as well as practicing, teachers reported high anxiety about the use of technology. When faced with higher anxiety levels, it has been shown that these individuals will tend to resist using computers or acquiring technology knowledge even though hardware and software is readily available (Doering et al.; Rovai & Childress, 2003).

Even when teachers do enter the profession with adequate training to integrate technology into instruction, there are still factors associated with the context surrounding the use of technology that determine teachers' successes or failures. Some of these factors included teacher development, administrative support, technological infrastructure, school's capacities for reforms, peer support, curriculum, and assessment (Cradler & Cradler, 2002; Roschelle, Pea, Hoadley, Gordin, & Means, 2002).

Though studies show a correlation between the level of computer skills exhibited by a teacher and the proficiency of students' technology use, most teachers still do not receive

adequate training in the use of technology (Roschelle et al., 2002). A NetDay (2001) survey noted that:

Teachers cite [sic] a lack of knowledge about how to use the web effectively, inappropriate materials on the web, lack of knowledge about good access, lack of good lessons that use technology, and too much information as reasons for not logging on. (n. p.)

Of course, there is only so much time that teachers can devote to learning how to use and implement technology. Overwhelmingly, teachers reported that lack of time was the biggest barrier to using instructional technology; 60% of the teachers reported using the Internet for fewer than 30 minutes a day (NetDay, 2001). A lack of time may help explain why some integrated learning systems (ILS) are not as effective as they might otherwise be. One study found that students typically spent only 35% of the recommended time on ILS instruction; some spent less than 15% of the recommended time, which can work out to as little as 10 minutes per week (Kulik, 2003).

Not surprisingly, a teacher's willingness and intrinsic motivation to learn about and implement technology can play a key role in how often and to what extent technology is implemented in a classroom. A study by Vannatta and Fordham (2004) measured teachers' dispositions about a number of factors not directly related to technology to see how those predictor variables would impact technology integration. The variables measured were:

1. teacher self-efficacy,
2. teacher philosophy,
3. openness to change,
4. amount of professional development,
5. amount of technology training,
6. years of teaching,
7. hours worked beyond the contractual work week, and

8. willingness to complete graduate courses without salary incentive (p. 254).

The researchers found several patterns that seemed to indicate that technology was not being used to its fullest potential. Use among teachers and students was fairly low. Although teachers did use word processing, e-mail, and accessed the Internet several times or more per semester, students used only word processing and the Internet more frequently than once or twice per semester. Teachers used digital cameras, databases, spreadsheets, and presentation software only once or twice per semester in general.

The researchers' (Vannatta & Fordham, 2004) findings suggested that not only was training in technology important in developing teachers who were capable of integrating technology, but it was also important that the teacher be willing to commit his or her own time in the pursuit of learning technology *and* have the willingness to take instructional risks. The combination of these attributes seemed to be the best predictor for technology-use within the classroom).

Another barrier to effective implementation of educational technology was the considerable effort it took to change pedagogical practice to support new teaching and learning methods conducive to the use of technology. Bruner (1996) warned of the difficulties faced when attempting to change the teaching practices of another:

In theorizing about the practice of education in the classroom (or any other setting for that matter), you had better take into account the folk theories that those engaged in teaching and learning already have. For any innovations that you, as a “proper” pedagogical theorist, may wish to introduce will have to compete with, replace, or otherwise modify the folk theories that already guide both teachers and pupils. (p. 46)

Wang's (2002) study showed that some teachers were naïve regarding how technology could support teaching and learning. In his study of preservice teachers, it was shown that most gravitated toward the use of computers as teacher-centered tools even though they predicted they would employ a student-centered approach to using technology. The use of computers with

student-centered activities require “different strategies, including scheduling the computer equipment, using different classroom management skills, designing curriculum-related activities, and developing evaluation methods accordingly” (p. 155). Furthermore, Reeves (2002) suggested that students were more comfortable with direct instruction than the mental intensity required from student-centered uses of technology. As noted by Scarpa (2003), a study by the Pew Internet and American Life Project reported that many students had found assignments involving the Internet at school as “poor and uninspiring” even though they were far more absorbed when using the Internet at home (p. 15).

Spodark (2003) found that a lack of vision and leadership was also a factor that discouraged teachers from implementing technology into the curriculum. In the absence of a vision for implementing technology including clearly defined strategies and applications, individuals are often left to fend for themselves. In such an environment, an eclectic mix of applications by various faculty members can place an “enormous strain on the available technology support system” (p. 16). The lack of a well-defined vision for implementing technology is a symptom of a lack of leadership. Unfortunately, even when the positions of technology director and facilitators exist to help teachers use and implement technology, they are usually viewed by faculty members as individuals in support positions rather than leaders (Spodark). This perception is supported by the NetDay (2001) survey that determined 73% of teachers did not feel pressure to integrate the Internet into instruction. Thirty-two percent of the teachers surveyed specifically stated that a lack of leadership was a factor that had prevented the integration of the Internet and curriculum. Often, technology coordinators who were hired to help teachers make the connection between technology and the curriculum had found themselves occupying a position closer to an “electric janitor” in which they were responsible for maintaining hardware (Shields, 2003). Only 10% of the respondents said that they felt pressure from their principals to use the Internet (NetDay).

Reeves (2002) pointed out that one reason principals may not push for technology-based activities that stress higher-order thinking skills is because of the current demands of mandatory testing. Many researchers stated that norm-based standardized tests were ill-equipped to measure the extent that technology is able to foster independent thinking and active learning in children (Benton Foundation, 2003; Roschelle et al., 2002). The study conducted by Roschelle et al. determined that tests designed to measure the reasoning abilities of children and their abilities to display an indepth knowledge of concepts were far better at measuring the contribution of technology. Roschelle et al. observed:

Compared with peers who learned algebra through conventional methods, urban high school students using a computer-based algebra tutor system performed much better on tests that stressed their ability to think creatively about a complex problem over a longer time period, but showed only a small advantage on standardized tests that do not adequately measure such higher-order thinking skills. (p. 91)

As noted by the Benton Foundation (2003), some educational groups, business groups, and policy groups that advocate the use of technology to advance student-centered activities and project-based learning are asking for new assessment tools that will better measure information literacy skills.

It is fair to say that those advocating the use of technology in classrooms envision a systemic change in which the roles of teachers and students change. Though technology can be used as a catalyst for such change, the factors discussed above have severely inhibited such reform on a wide-scale basis. That is not to say that teachers have resisted all use of technology; clearly, they have not (NetDay, 2001). Nevertheless, Cuban (2001) viewed the educational technology revolution as a bad investment stating, “The teachers that we interviewed and observed, however, engaged mostly in incremental changes. Only a tiny band of teachers moved toward deeper, major reform. These findings and outcomes will disappoint champions of better and faster technology in schools” (p. 135).

Supporting the Use of Educational Technology

No one can dispute the amazing advances in computer hardware and software over the past two decades. Though some factors still prevent many teachers from properly implementing instructional technology, studies seem to suggest that it is becoming more effective. This is often attributed to the faster speed of computers that makes it possible to run sophisticated, yet user-friendly, software. Of course, software is not the only thing becoming more sophisticated. Users including students and teachers are also becoming more computer-literate in ways that are making the task of educating more effective (Kulik, 2003). It is hard to draw conclusions from even moderately dated studies as changes in the quality and quantity of technology in schools render an environment that is different from the technological landscape of the recent past (Waxman et al., 2002).

Studies have revealed that students tend to spend more time on task in classrooms where technology is used a moderate amount as opposed to little or none (Cradler, McNabb, Freeman, & Burchett, 2002; Waxman et al., 2002) However, today's educators and administrators often seek evidence that implementing technology holds the potential to increase standardized test scores. In fact, studies do exist that seem to support such a conclusion. However, the biggest gains from using technology in the classroom are realized when the application directly addresses the tested curriculum standards (Cradler et al.).

Reading management programs, such as Accelerated Reader that help guide and track students' reading, have been associated with higher standardized test scores. Kulik (2003) gave as an example Shelby Oaks Elementary School, in Memphis, Tennessee. The fourth through sixth graders who used Accelerated Reader at the school scored 95% higher than the national average gain on the Tennessee Value-Added Assessment System; this was equivalent to two years' worth of growth in just one year. Interestingly, the students also made significant gains in the subjects of math (28% higher than the national gain) and language (67% higher than the

national gain). The meta-analysis conducted by Kulik determined, “Reading scores are higher at schools that own AR and lower at schools that do not own the program” (p. 38).

Integrated Learning Systems (ILS) do not seem to have the same potential for increasing achievement in reading that management programs have. However, research did substantiate the use of ILS for improving standardized test scores in mathematics. Of seven studies conducted on the matter, none found a negative correlation and all but one showed statistically significant positive correlations. Kulik (2003) pointed out the difference by stating, “This suggests that students receiving ILS instruction in mathematics would perform at the 66th percentile on mathematics tests whereas comparable students receiving conventional instruction only would perform at the 50th percentile” (p. 20).

Other studies showed that technology held promise in elevating the demonstrable achievement levels of students in other subject areas as well. In one report by Boster, Meyer, Roberto, and Inge (2002), 913 students and 38 teachers from 13 schools participated in a study designed to measure the effects of video streaming applications on standardized test scores in the subjects of science and social studies. The experimental group that received instruction in conjunction with the streaming videos performed substantially better in both subjects at the third-grade level than did those children in the control group. Another longitudinal study conducted at the Hampshire’s Brewster Academy found that “[S]tudents participating in the technology-integrated school-reform efforts (School Design Model) demonstrated average increases of 94 points in combined SAT I performance over students who participated in the traditional school experience” (Cradler et al., 2002, p. 47).

Some are quick to mention that it is not the direct effects of technology that can create the biggest gains, but rather the indirect use of technology in the pursuit of better ways of teaching and learning that yields the greatest payoff. Project-based learning (PBL) is an example of an activity that is dependent upon technology to help challenge students to become active

learners in order to solve real-life problems. Solomon (2003), the director of TechLearning.com, explained the vital role technology could play in PBL:

Students use tools such as word processors, spreadsheets, and databases to perform tasks like outlining, drafting essays, analyzing numerical data, and keeping track of collected information. E-mail, electronic mailing lists, forums, and other online applications facilitate communication and collaboration with the world outside the classroom. The Web provides access to museums, libraries, and remote physical locations for research. Students can create electronic compositions of art, music, or text collaboratively; participate in a simulation or virtual world; and work together to accomplish a real task or to improve global understanding. And all work can be published on the Web for review by real audiences, not just a single teacher, class, or school. (p. 22)

Studies into the effectiveness of PBL seem to confirm that students can perform well on standardized tests in addition to having a greater understanding of concepts and retention of subject matter. As noted by Solomon, in a Title I school in Memphis that used PBL as the primary basis of reform, students attaining proficient levels in writing jumped from 6% to 77% in just two years.

In some cases, the use of technology may make a larger difference in achievement for certain subgroups. A study by Chung (2002) analyzing math and reading scores of fifth graders from 1,381 Pennsylvania school data files in relation to the reported number of computers and Internet connections found that schools with a higher percentage of socioeconomically disadvantaged students performed substantially better on the Pennsylvania System of School Assessment (PSSA) in both math and reading when there was a higher ratio of computers per students. The researcher also found that the same population performed substantially better on the PSSA for both math and reading in schools that had a higher Internet connection per student ratio (Chung).

Hope, Promise, and Caution

The federal government's sustained hope that technology can improve learning is evident in the *No Child Left Behind Act* that "...establishes technology literacy as a core foundation for learning, calling for academic excellence in the context of modern technologies" (Lemke, 2003, p. 9). As stated by Yepes-Baraya (2002), the Office of Educational Research and Improvement of the U.S. Department of Education has a vision for educational technology that depends upon the core concepts of school reform and the integration of emerging technologies into everyday teaching and learning. It is becoming readily accepted that technology alone will be insufficient to create the substantial change envisioned by reformers. According to Yepes-Baraya, changes in achievement brought about through the use of technology will be dependent upon multiple variables, including "the goals and resources for instruction, the cognitive demands of the learning, the extent to which all learners' needs are considered, the teachers' comfort and skill with technology, and of course, the types of technology available" (p. 140).

The creation of separate school improvement plans dealing with curriculum and technology alluded to the fact that technology and curriculum were still not connected in a meaningful way (Porter, 2003a; Shields, 2003). Yet, the resources that technology makes available to students and teachers to address curriculum are enormous. Dyrli (2003) said that the Responsible Netizen Institute noted 25 pages of new information being added to the Web every second. Porter (2003b), a consultant dedicated to helping districts implement technology in meaningful ways, made the point that it is no longer enough for students to "go look it up" by asserting, "With the exponential growth of information, we can no longer rely solely on our individual learning. Learning communities that share their expertise increase our own capacity to deal with the exponential growth of information in meaningful ways" (p. 15).

While the attrition of mature educators who were well established in their pedagogy when computers became a factor in instruction might present opportunities for younger teachers who have been trained to use technology, it is still important that the technology be linked to

content-specific uses (Shields, 2003). Porter (2003a) noted that using technology to do the same things that one does without technology does not create substantial change. Other researchers added that 30% to 50% of content and instructional strategies needed to change in a school before it could realize an increase in overall learning (Joyce, Hopkins, & Calhoun, 1999).

Multiple studies have shown that certain key factors must be in place before the implementation of educational technology can play a significant role in school reform.

According to one study conducted by Roschelle et al. (2002), these factors included:

1. technology access and technical support;
2. instructional vision and a rationale linking the vision to technology use;
3. critical mass of teachers in technology activities;
4. high degree of collaboration among teachers;
5. strong leaders; and
6. support for teacher-time for planning, collaborating, and reporting technology use. (p. 78)

Porter (2003a) agreed that it was possible for the combination of the above factors to create an environment in which technology is a tool used to support complex and inventive thinking of students in such a way that it raises their basic skills by helping them become better thinkers.

Vannatta and Fordham (2004) suggested through their research that improved implementation of technology could be realized through the combination of effective training and certain key characteristics such as a willingness to work on one's own time without additional compensation and a willingness to take risks. Other researchers suggested that teachers be provided with:

1. Technology training in which teachers personally experience technology's power as a learning tool (Guskey, 1986; Poloni, 2001).
2. Technology training combined with practitioner reflection and numerous demonstrations of effective technology-enhanced lessons (Burns, 2002).

3. Regular opportunities for collaboration and reflection with colleagues to discuss pedagogy, instructional practices, and research-based practices (Burns; Cobb, Wood, & Yackel, 1990; Johnson & Owen, 1986).
4. Opportunities for discussion and reflection on one's dispositions and attributes that are brought to the teaching profession and how that affects student's learning (Johnson & Owen).
5. A positive leader who values teachers as learners, research-based practices, and informed risk taking (Burns)
6. Modeling of risk behaviors with technology (Vannatta & Fordham, 2004).

Summary

The beginning of this chapter highlighted some of the initiatives that have helped districts create a formidable technological infrastructure, including hardware, software, and connectivity. Teachers and students now have more access to technology and information via the Internet than they have had at any time in the past. Unfortunately, researchers have shown that this enormous investment in technology has yet to yield dramatic improvements in students' achievement on anything but a limited basis as reflected by improvements in standardized test scores.

Nevertheless, educational technology still holds the power to transform teaching and learning in new ways that foster independent thinkers capable of finding, managing, and publishing information in ways that do boost achievement. However, technology alone cannot accomplish this mission; a variety of factors must combine to create substantial change. Some of these factors include the attitudes and pedagogy of educational practitioners, the importance administrators place on the use of educational technology, and the infrastructure of the technology itself.

This study examined some of the aforementioned factors to determine how the state of educational technology in Tennessee as reflected on the E-TOTE surveys correlated to students' achievement.

CHAPTER 3

METHODOLOGY

This chapter describes the methodology and procedures used in this study to determine how factors related to the use, implementation, and quantity of educational technology affected the advanced proficiency levels of third and fifth graders in the subjects of math and reading. The chapter is organized into the following sections: research design, population, instrumentation and data collection, data analysis, hypothesis for regression models, and summary.

Research Design

This study sought to use multiple sources of data to answer several questions related to educational technology. The researcher used available data to describe the extent to which educators were integrating technology into instruction, their perceived levels of professional development in instructional technology, and the infrastructure for technology. These factors were examined in relation to the district's per-pupil expenditure and the socioeconomic status of the school's student population. This study also sought to determine to what extent a variety of factors including those associated with instructional technology influenced the percentage of students who were able to achieve advanced proficiency levels on a state-wide criterion-referenced test in the subjects of math and reading in third and fifth grades. Data from the study came from two state-mandated sources. One was the 2003 Tennessee Comprehensive Achievement Test (TCAP) that was given to students throughout the state in grades three through eight in the spring of 2003. A new criterion-referenced section was added to the third, fifth, and eighth grade administration of the test in 2003 to help determine proficiency levels in math and reading as mandated by the *No Child Left Behind* Act. The other source of data came from a state department initiative designed to assess the condition of educational technology as

required by the acceptance of federal EdTech funds that are allocated by the *No Child Left Behind* Act. Principals from every school in each district that opted to receive the EdTech formula funds from the state were required to complete the EdTech Tennessee Online Technology Evaluation (E-TOTE) survey (see Appendix).

Descriptive statistics were employed to describe the amount of technology implementation and integration, the perceived levels of professional development in instructional technology, and the infrastructure for technology within the schools that responded to the E-TOTE survey. A three-step hierarchical regression model was used to determine the effects of technological characteristics in those schools on the proficiency levels of third and fifth graders in math and reading.

There is an obvious desire on the part of those working in the field of educational technology, like myself, to see a positive relationship between an increased use and capacity of educational technologies and higher proficiency scores. However, because the data for this study already existed and were collected independently from two different instruments, bias was not a factor in the outcome of the results.

Population

The population being studied was limited to those public schools throughout Tennessee that had third and fifth graders and an E-TOTE survey record; this number comprised 1,066 schools. Many of these were elementary schools that had both third and fifth grades. However, some schools had one grade but not the other.

Instrumentation and Data Collection

The E-TOTE survey instrument was developed by Jerry Bates, the Director of Applied School Technology for Tennessee. The investigator had no input into the design of the survey instrument. One limitation of the E-TOTE survey was that questions were not disaggregated by

grades or teachers. Instead, one answer was given for the entire school in response to each question regarding the implementation of technology and the state of professional development. It was assumed that the answer given was an approximate average for all grades and teachers within the school. With the permission of Dr. Bates, an Excel spreadsheet containing the data from all of the E-TOTE survey submissions was analyzed.

The proficiency percentages from the criterion-referenced portion of the TCAP test were published along with various other test scores and demographic data as district and school “report cards” that were available for public inspection on the state department’s website. As this source of data was freely open to inspection, the researcher simply downloaded the data needed for the analysis.

Data Analysis

The following strategies were used to answer the stated research questions:

Research Question #1: To what extent were educators integrating technology into instruction, and did this usage seem to be related to the socioeconomic status of the school’s population or the district’s per-pupil expenditure?

To answer this research question, frequency counts and percentages for each of the following three E-TOTE questions were presented:

1. Impact of Technology on Teacher Role and Collaborative Learning.
 - a. Teacher-centered lectures; students use technology to work on individual projects
 - b. Teacher-directed learning; students use technology for cooperative projects in their own classrooms
 - c. Teacher facilitated learning; students use technology to create communities of inquiry within their own community

- d. Teacher as facilitator, mentor, and co-learner; and student-centered learning, teacher as mentor/facilitator with national /international business, industry, university communities of learning
2. What characterizes the overall pattern of teacher use of technology at your school?
- a. Teachers use technology as a supplement
 - b. Teachers use technology to streamline administrative functions (i.e., grade book, attendance, word processing, e-mail, etc.)
 - c. Teachers use technology for research, lesson planning, multimedia, and graphical presentations and simulations and to correspond with experts, peers, and parents
 - d. Integration of evolving technologies transforms the teaching process by allowing for greater levels of interest, inquiry, analysis, collaboration, creativity and content production
3. The instructional setting where and frequency when digital content is used are characterized by
- a. Occasional computer use in library or computer lab setting
 - b. Regular weekly computer use to supplement classroom instruction, primarily in lab and library settings
 - c. Regular weekly technology use for integrated curriculum activities utilizing various instructional settings (i.e.: classroom computers, libraries, labs, and portable technologies)
 - d. Students have on-demand access to all appropriate technologies to complete activities that have been seamlessly integrated into all core curriculum areas

With the aid of Pearson's correlation coefficient, the strength and the direction of the relationship between the perceived levels of technology integration and the school's proportion of economically disadvantaged students was determined. Pearson's correlation coefficient was also

used to determine the strength and the direction of the relationship between the perceived levels of technology integration and the district's per-pupil expenditure.

Research Question #2: How did educators perceive their levels of professional development in instructional technology and did this seem to be related to the socioeconomic status of the school's population or the district's per-pupil expenditure?

To answer this research question, frequency counts and percentages for each of the two following E-TOTE questions were presented:

1. When technology-related professional development occurs for your teachers, which describes the model that is most often used?
 - a. Whole group
 - b. Whole group, with follow-up to facilitate implementation
 - c. Long-term and ongoing professional development; involvement in a developmental/ improvement process
 - d. Creates communities of inquiry and knowledge building; anytime learning available through a variety of delivery systems; individually guided activities
2. Where are most of your teachers in terms of their understanding levels and patterns of technology use?
 - a. Most at entry or adoption stage (Students learning to use technology; teachers use technology to support traditional instruction).
 - b. Most at adaptation stage (Technology used to enrich curriculum) Most beginning to use with students
 - c. Most at appropriation stage (Technology is integrated, used for its unique capabilities)
 - d. Most at invention stage (Teachers discover and accept new uses for technology)

Again, Pearson's correlation coefficient was used to determine the strength and direction of the relationship between the perceived levels of professional development for instructional

technology and the socioeconomic status of the school's population. Pearson's correlation coefficient was also used to determine the strength and direction of the relationship between the perceived levels of professional development for instructional technology and the district's per-pupil expenditure.

Research Question #3: What was the infrastructure for technology and did this seem to be related to the socioeconomic status of the school's population or the district's per-pupil expenditure?

To answer this research question, frequency counts and percentages were presented for each of the two following E-TOTE questions:

1. How many students are there for each computer and how regularly are these computers replaced? ("refresh cycle")
 - a. Ten or more students per Internet-connected multimedia computer with a refresh cycle of every 6 or more years
 - b. Between 5 and 9 students per Internet-connected multimedia computer and a refresh cycle every 5 years
 - c. Four or fewer students per Internet-connected multimedia computer and a refresh cycle every 4 years
 - d. In addition to 4 or fewer students per Internet-connected multimedia computer, on-demand access for every student; refresh cycle three or fewer years
2. What best describes your school's local/wide area network (LAN/WAN)?
 - a. Limited print/file sharing network with some shared resources available on the school LAN
 - b. Most rooms connected to the LAN/WAN with student access available.
Minimum 10/100 Cat 5 hubbed network. High-end servers, such as Novell or NT servers, serve some applications

- c. All rooms connected to the LAN/WAN with student access; minimum 10/100 Cat 5 switched network; and high-end servers (such as Novell or NT) serving multiple applications
- d. All rooms connected to the WAN sharing multiple district-wide resources; school is connected to robust WAN with 100 MB/GB and/or fiber switched network that allows for resources such as, but not limited to, video streaming and desktop videoconferencing. Easy access to network resources for students and teachers, including some wireless connectivity

Pearson's correlation coefficient was used to determine the strength and direction of the relationship between the level of infrastructure for technology and the socioeconomic status of the school's population. Pearson's correlation coefficient was also used to determine the strength and direction of the relationship between the level of infrastructure for technology and the district's per-pupil expenditure.

Research Question #4: What relationships, if any, existed between the technological characteristics of Tennessee schools and the advanced proficiency levels of third and fifth graders in math and reading?

To answer Research Question #4, four hierarchical regression models were used:

Independent Variables for four hierarchical regression models:

Step 1:

Size of school (number of students)

Step 2:

Number of minority students

Number of economically disadvantaged students

Per-pupil expenditure

Step 3:

Integration of technology

Educator preparation and development

Infrastructure for technology

Number of mid and high capacity computers

Dependent Variables for four hierarchical regressions

Advanced reading proficiency of third graders

Advanced reading proficiency of fifth graders

Advanced math proficiency of third graders

Advanced reading proficiency of fifth graders

The predictor variable for the number of minority students was created by summing the number of African American, Hispanic, Asian, Native American, and Pacific Islander students. This information was taken directly from each school's published report card.

The criterion variable for the number of economically disadvantaged students was created by multiplying the percentage displayed on the school's report card by the number of students in the school.

The predictor variable for per-pupil expenditure was taken from the published district report card corresponding to the district in which that school was located. Per-pupil expenditures are a single number reported for all schools in the district that is calculated by dividing the amount of revenue available to the district by the number of students within the district.

The predictor variables of integration of technology, educator preparation and development, and infrastructure for technology were created by summing the numeric responses to the E-TOTE items that made up each category and dividing by the number of items in that section. The independent variable for mid- and high-capacity computers was created by simply summing the counts for each.

The four criterion variables were third and fifth graders whose scores were classified as "Advanced Proficiency" in math and reading on the school's report card.

Hypotheses for Regression Models

This study will test the following null hypotheses:

- HO₁ There is no relationship between the proportion of economically disadvantaged students or district's per-pupil expenditure and level of technology integration.
- HO₂ There is no relationship between the proportion of economically disadvantaged students or district's per-pupil expenditure and level of professional development.
- HO₃ There is no relationship between the proportion of economically disadvantaged students or district's per-pupil expenditure and level of technology infrastructure.
- HO₄ There is no relationship between the size of the school and third and fifth graders' proficiency in reading and math.
- HO₅ There is no relationship between the number of minority students and third and fifth graders' proficiency in reading and math.
- HO₆ There is no relationship between the number of economically disadvantaged students and third and fifth graders' proficiency in reading and math.
- HO₇ There is no relationship between the per-pupil expenditure and third and fifth graders' proficiency in reading and math.
- HO₈ There is no relationship between the level of technological integration and third and fifth graders' proficiency in reading and math.
- HO₉ There is no relationship between the levels of educators' preparation and professional development and third and fifth graders' proficiency in reading and math.
- HO₁₀ There is no relationship between infrastructure for technology and third and fifth graders' proficiency in reading and math.
- HO₁₁ There is no relationship between the percentage of mid- and high-capacity computers and third and fifth graders' proficiency in reading and math.

Summary

The study results were derived from quantitative data obtained from both the E-TOTE surveys and the criterion-referenced portion of the TCAP for third and fifth graders. The test and demographic data came directly from the district's and school's report card data published on the internet website. The E-TOTE data was received in the form of a spreadsheet from Dr. Jerry Bates, at the Tennessee State Department of Education. Both descriptive statistics and regression models were used to analyze the data. Results from the analysis are presented in Chapter 4.

CHAPTER 4

RESULTS

The purpose of this study was to describe the perceived extent to which educators were integrating technology into instruction, perceived levels of professional development in instructional technology, and the infrastructure for technology. Each of these factors was examined in relation to the district's per-pupil expenditure and the socioeconomic status of the school's student population as measured by the proportion of economically disadvantaged students. The study also sought to investigate the effects of various factors associated with instructional technology on advanced proficiency levels on a state-wide criterion-referenced test for third and fifth graders in the subjects of math and reading after controlling for other nontechnical factors such as school size, minority population, number of economically disadvantaged students, and per-pupil expenditure.

The data for this study came from two independent sources both of which evolved from requirements of the *No Child Left Behind* legislation. The aforementioned criterion-referenced test was a new section added to the state's TCAP standardized test. The criterion-referenced portion was given only to third, - fifth, - and eighth-grade students. The results from this test were published for each school on the state's website. Data about the nontechnical factors were also found on the state's website. The other source of data was an online survey called E-TOTE that was presented to all principals who chose to accept EdTech formula funds. Only one survey could be completed per school. The results of this survey were collected in the form of an Excel spreadsheet and provided by Dr. Jerry Bates for the purpose of conducting this research. All calculations were performed using SPSS.

Although 1,657 schools submitted an online survey, the spreadsheet was distilled to eliminate any schools that did not offer a third or fifth grade. There were 1,066 schools that met

those criteria. As reported on the 2003 Tennessee Report card, a median of 470 students was in each school with the minimum number being 10 students and the maximum number being 1,614. The percentage of minority students varied from 0 to 100, with a median value of 10.86%. The percentage of economically disadvantaged students also varied greatly from a minimum of 0 to a maximum of 100%. Values for 17 of the identified schools were missing for this variable and could not be obtained. The median percentage of economically disadvantaged students was 56.10%. Per-pupil expenditure ranged from \$4,886 to \$9,874. The median per-pupil expenditure was \$6,475. The number of mid- and high-capacity computers at the 1,058 schools that listed a value ranged from 0 to 382 with a median of 74.

On the survey questions, the overall score for the integration of technology into instruction could fall into the range of any whole number between 1 and 4. The mean score for this category was 2.01 with a standard deviation of .599. The possible range for the educators' perception of levels of professional development was the same. The mean on this question was 2.05 with a standard deviation of .707. The overall score for the infrastructure for technology could exist in the same range as the previous two questions. The mean for this item was 2.14 with a standard deviation of .662.

Because not all the identified schools necessarily had both a third and a fifth grade, a fewer number of values were examined on the report card in terms of the percentage of students who received the advanced proficiency levels in math and reading. The percentage of third-grade students achieving the advanced proficiency levels in math in the 963 schools that had third grades had a range from 0 to 100. The mean for these schools was 30.62% with a standard deviation of 16.31. The percentage of third-grade students achieving advanced proficiency levels in reading in the 963 schools that had third grades also had a range from 0 to 100. The mean for these schools was 30.13% with a standard deviation of 15.89. The percentage of fifth-grade students achieving advanced proficiency levels in math in the 897 schools that had fifth grades had a range from 0 to 95. The mean for these schools was 30.61% with a standard

deviation of 16.94. The percentage of fifth-grade students achieving advanced proficiency levels in reading in the 897 schools that had fifth grades had a range from 0 to 93. The mean for these schools was 29.81% with a standard deviation of 15.80.

Analysis of Data for Research Questions and Null Hypotheses

Descriptive statistics were employed to describe the perceived amount of technology implementation and integration, the perceived levels of professional development in instructional technology, and the infrastructure for technology as reported on the E-TOTE survey. Pearson's correlation coefficient was used to determine the strength and direction of the relationships between both the school's proportion of economically disadvantaged students and district's per-pupil expenditure with levels of technology integration, perceived levels of professional development, and levels of technology infrastructure.

Research Question #1

To what extent are educators integrating technology into instruction, and did this usage seem to be related to the socioeconomic status of the school's population or the district's per-pupil expenditure?

Frequency counts and percentages were examined for the given responses of three E-TOTE questions. The respondents had been asked to choose one of four possible answers for each question/statement. Table 1 presents the frequency responses for the first question evaluated in this section.

Table 1

Impact of Technology on Teachers' Roles and Collaborative Learning

Score	Response	Frequency	Percent	Cumulative Percent
1	Teacher-centered lectures; students use technology to work on individual projects	473	44.4	44.4
2	Teacher-directed learning; students use technology for cooperative projects in their own classrooms	496	46.5	90.9
3	Teacher facilitated learning; students use technology to create communities of inquiry within their own community	73	6.8	97.7
4	Teacher as facilitator, mentor, and co-learner; and student-centered learning, teacher as mentor/facilitator with national/international business, industry, university communities of learning	24	2.3	100.0
Totals		1,066	100.0	

As shown in Table 1, the vast majority (90.9%) of the schools surveyed reported that technology was not making as much of an impact on the teacher's role in the classroom or as much impact on collaborative learning as possible.

Table 2 describes the frequency counts and percentages of the responses concerning the overall pattern of teachers' use of technology.

Table 2

Characterizing the Overall Pattern of Teachers' Use of Technology

Score	Response	Frequency	Percent	Cumulative Percent
1	Teachers use technology as a supplement.	291	27.3	27.3
2	Teachers use technology to streamline administrative functions (i.e., grade book, attendance, word processing, e-mail, etc.)	407	38.2	65.5
3	Teachers use technology for research, lesson planning, multimedia and graphical presentations and simulations, and to correspond with experts, peers, and parents.	344	32.3	97.7
4	Integration of evolving technologies transforms the teaching process by allowing for greater levels of interest, inquiry, analysis, collaboration, creativity and content production.	24	2.3	100.0
Totals		1,066	100.0	

One can see by the responses listed in Table 2 that respondents perceive teachers to be generally adept at using technology for a wide array of purposes falling short of integrating technology to the point of transforming the teaching process.

Table 3 describes the frequency counts and percentages of responses concerning the characterization of when and where digital content is used.

Table 3

Characterizing Where and When Digital Content is Used

Score	Response	Frequency	Percent	Cumulative Percent
1	Occasional computer use in library or computer lab setting	205	19.2	19.2
2	Regular weekly computer use to supplement classroom instruction, primarily in lab and library settings	411	38.6	57.8
3	Regular weekly technology use for integrated curriculum activities utilizing various instructional settings (i.e., classroom computers, libraries, labs, and portable technologies)	408	38.3	96.1
4	Students have on-demand access to all appropriate technologies to complete activities that have seamlessly integrated into all core curriculum areas	42	3.9	100.0
Totals		1,066	100.0	

It appears that the majority of students at schools responding to this question do use technology in some form or fashion on a regular weekly basis although only 19% use technology occasionally.

The researcher was interested in examining the relationship between the perceived level of technology integration and the socioeconomic status of the student population, as measured by the proportion of economically disadvantage children as well as how it related to the district's per-pupil expenditure. For the purposes of this research, the investigator created a new variable

to represent the overall impact of technology on the teacher's role and collaborative learning. The three questions presented in Tables 1, 2, and 3 formed the basis for the technology integration score. The mean of these three questions was used as the overall technology score. Pearson's correlation coefficient was used to evaluate the strength and direction of the relationship between the perceived levels of technology integration and the school's proportion of economically disadvantaged students.

Although 1,066 schools answered survey questions, data about the proportion of economically disadvantaged students were missing for 17 schools. Therefore, at a size (N) of 1,049, the Pearson's correlation coefficient (r) was $-.046$ with a probability (p) of $.138$. The Pearson's correlation showed a very weak, negative relationship between the levels of technology integration and the proportion of economically disadvantaged students in a school's population. However, because the probability was greater than the preset alpha of $.05$, the null hypothesis was retained when examining how much teachers integrate technology in relation to the school's proportion of economically disadvantaged students.

Pearson's correlation coefficient was also used to evaluate the strength and direction of the relationship between the perceived levels of technology integration and the district's per-pupil expenditure. At a size (N) of 1,066, the Pearson's correlation coefficient (r) was $.094$, with a probability (p) of $.002$. Because the probability level was less than the preset alpha of $.05$, the null hypothesis was rejected when examining how much teachers integrate technology in relation to the district's per-pupil expenditure. It is worth noting that the positive relationship was extremely weak. In fact, even though it was statistically significant, substantively, the finding was unimportant.

Research Question #2

How did educators perceive their levels of professional development in instructional technology and did this seem to be related to the socioeconomic status of the school's population or the district's per-pupil expenditure?

Frequency counts and percentages were examined from two questions taken from the Educator Preparation and Development section of the E-TOTE survey. Table 4 presents the responses related to the type of model used for technology-related professional development.

Table 4

Technology-Related Professional Development Model Used Most Often

Score	Response	Frequency	Percent	Cumulative Percent
1	Whole group	267	25.0	25.0
2	Whole group, with follow-up to facilitate implementation	375	35.2	60.2
3	Long term and ongoing professional development; involvement in a developmental/improvement process	373	35.0	95.2
4	Creates communities of inquiry and knowledge building; anytime learning available through a variety of delivery systems; individually guided activities	51	4.8	100.0
Totals		1,066	100.0	

As Table 4 shows, there was a diverse range of models used in the delivery of technology-related professional development activities. However, few (4.8%) of those responding to the survey admitted to creating communities of inquiry and knowledge building for faculty members.

Table 5 presents the frequency counts and percentages of responses about patterns of technology use that related to the teachers' levels of understanding.

Table 5

Patterns of Technology Use Coinciding to Levels of Understanding

Score	Response	Frequency	Percent	Cumulative Percent
1	Most at entry or adoption stage (Students learning to use technology; teachers use technology to support traditional instruction)	347	32.6	32.6
2	Most at adaptation stage (Technology used to enrich curriculum)	515	48.3	80.9
3	Most at appropriation stage (Technology is integrated, used for its unique capabilities)	171	16.0	96.9
4	Most at invention stage (Teachers discover and accept new uses for technology)	33	3.1	100.0
Totals		1,066	100.0	

According to survey responses, it appeared that a clear majority of teachers (80.9%) found themselves in an early stage, either adoption or adaptation, of understanding concerning how they used technology instructionally.

Choices about professional development activities are usually made at both the school level and the district level. One might assume that the type of professional development offered to teachers would be based upon schools or districts' needs. The researcher was interested to see how the economic realities at both levels might affect the perceived level of professional development in the area of instructional technology.

To address this question, the researcher created a new variable to represent the overall level of technology-related professional development. The overall level of professional development was simply the mean of the two E-TOTE items shown in Tables 4 and 5.

Pearson's correlation coefficient was used to determine the strength and direction of the relationship between the perceived levels of professional development in instructional technology and the proportion of economically disadvantaged students. At a size (N) of 1,049, the Pearson's correlation coefficient (r) was .001, with a probability (p) of .981. Therefore, this part of the summary null hypothesis must be retained.

Pearson's correlation was also used to evaluate the strength and direction of the relationship between the perceived levels of professional development in instructional technology and the district's per-pupil expenditure. At a size (N) of 1,066, the Pearson's correlation coefficient (r) was .083, with a probability of (p) of .007. Because the probability was less than the preset alpha of .05, this part of the null hypothesis must be rejected. The Pearson's correlation showed a weak positive relationship between per-pupil expenditure and the overall perception of technology-related professional development.

Research Question #3

What was the infrastructure for technology and did this seem to be related to the socioeconomic status of the school's population or the district's per-pupil expenditure?

Once again, frequency counts and percentages were examined for two of the questions found in the Infrastructure for Technology section of the E-TOTE survey. Table 6 describes the responses to the question inquiring about student-computer ratios and refresh cycles for computers. A refresh cycle refers to how often old computers are replaced.

Table 6

Student-to-Computer Ratios and Refresh Cycles

Score	Response	Frequency	Percent	Cumulative Percent
1	Ten or more students per Internet-connected multimedia computer with a refresh cycle of every 6 or more years	429	40.2	40.2
2	Between 5 and 9 students per Internet-connected multimedia computer and a refresh cycle every 5 years	460	43.2	83.4
3	Four or fewer students per Internet-connected multimedia computer and a refresh cycle every 4 years	156	14.6	98.0
4	In addition to 4 or fewer students per Internet-connected multimedia computer, on-demand access for every student; refresh cycle 3 or less years	21	2.0	100.0
	Totals	1,066	100.0	

The survey responses showed that a high student to computer ratio existed in many schools throughout the state, with 40.2% having 10 or more students per Internet-connected computer. Furthermore, 83.4% of the schools had computers that are likely considered outdated as defined by a refresh cycle of five or more years.

The frequency counts and percentages of responses related to the description of the local area network (LAN) and wide area network (WAN) within schools are noted in Table 7.

Table 7

Description of Schools' Local/Wide Area Networks

Score	Response	Frequency	Percent	Cumulative Percent
1	Limited print/file sharing network with some shared resources available on the school LAN	188	17.6	17.6
2	Most rooms connected to the LAN/WAN with student access available. Minimum 10/100 Cat 5 hubbed network. High-end servers, such as Novell or NT servers, serve some applications	232	21.8	39.4
3	All rooms connected to the LAN/WAN with student access; minimum 10/100 Cat 5 switched network; and high-end servers (such as Novell or NT) serving multiple applications	582	54.6	94.0
4	All rooms connected to the WAN sharing multiple district-wide resources; school is connected to robust WAN with 100 MB/GB and/or fiber switched network that allows for resources such as, but not limited to, video streaming and desktop videoconferencing. Easy access to network resources for students and teachers, including some wireless connectivity	64	6.0	100.0
Totals		1,066	100.0	

Nearly 55% of those responding to this question indicated that all rooms within their schools were connected to a high-capacity network and using a high-end server application whereas over 82% had most or all rooms connected. Clearly, the development of school networks seemed to be at a rather advanced state.

The investigator used a Pearson's correlation coefficient once again to determine the strength and direction of relationships between the schools' technology infrastructure and the socioeconomic status of the schools' populations. The mean of the two E-TOTE questions shown in Tables 6 and 7 was used to reflect the overall school technology structure. At a size (N) of 1,049, the Pearson's correlation coefficient (r) was $-.042$, with a probability (p) of $.174$. Because the probability was greater than the preset alpha of $.05$, this part of the null hypothesis must be retained.

The researcher also used a Pearson's correlation coefficient to determine the strength and direction of relationships between the schools' technology infrastructure and the school districts' per-pupil expenditures. At a size (N) of 1066, the Pearson's correlation coefficient (r) was $-.053$, with a probability (p) of $.082$. Because the probability was greater than the preset alpha of $.05$, the null hypothesis was retained.

Research Question #4

What relationships, if any, existed between the technological characteristics of Tennessee schools and the advanced proficiency levels of third and fifth graders in reading and math?

To answer this question, four hierarchical regression models were used. The criteria variables for the four regression models were, respectively, the percentage of students who scored within the advanced proficiency levels for third-grade math, third-grade reading, fifth-grade math, and fifth-grade reading. For each model, the size of the school, as measured by the number of students on the school's report card, was entered into the model first. In the second step, three predictor variables representing school characteristics were entered into the model: the number of minority students; the number of economically disadvantaged students; and per-pupil expenditure. In the third step, the four predictor variables related to technology were entered into the model: the overall integration of technology, overall educator preparation and development, overall infrastructure for technology, and the number of mid- and high-capacity

computers. The overall scores for integration, educator preparation and development, and infrastructure were measured by the mean of the items included in each concept.

Table 8 displays the implications of the predictor variables on the advanced proficiency levels of third-grade students in the subject of math. The second step of the regression model showed that the size of school, number of minority students, number of economically disadvantaged students, and per-pupil expenditure, taken together, accounted for 40.6% of the variance in advanced proficiency math scores for third graders. Of those predictor variables, the size of the school, number of minority students, and number of economically disadvantaged students all exhibited significant p values. Per-pupil expenditure was not statistically significant.

The Standardized Beta coefficient for size of school ($B=.469$) was indicative of a moderately strong, positive relationship between school size and advanced proficiency levels. A somewhat weak, negative relationship existed between the number of minority students and advanced proficiency levels ($B=-.261$). A stronger but still moderate negative relationship existed between the number of economically disadvantaged students and proficiency levels ($B=-.577$).

When the technology related predictor variables were added in step three of the regression model, there was only a scant jump in the explanation of variance from 40.6% to 41.3%. A difference of only .007 in the R^2 values between the second and final step indicated that the technology related factors accounted for only a miniscule amount of additional variance in the advanced math proficiency of third graders. In the final step of the regression model, the size of school, number of minority students, and number of economically disadvantaged students retained significant p values and relationships similar to those found in the second step. Of the technology variables, only technology integration exhibited a significant p value (.027). However, the relationship between integration and third-grade advanced proficiency in math cannot be considered substantively important because of the extremely weak Beta of .072.

and proficiency levels. The positive Beta of the per-pupil expenditure predictor variable was too slight to be considered significant.

When the technology related predictor variables were examined in step three of the regression model, there was only a diminutive jump in the explanation of variance from 40.6% to 41.3%. A difference of only .007 in the R^2 value between the second and final step indicated that the technology related factors accounted for only a miniscule difference in recorded proficiency levels for third graders in the subject of reading. Of the variables examined, the size of school, number of minority students, and number of economically disadvantaged students retained significant p values and similar relationships in the third step. Though the predictor variables of per-pupil expenditure and technology integration did exhibit a significant p values, with Betas of .079 and .077 respectively, they cannot be considered significant indicators.

Table 9

Hierarchical Multiple Regression Analysis of the Effects of School Size, Other School Characteristics, and Technology on Grade Three Reading Advanced Proficiency

	Size of School			Size of School and Other School Characteristics			Size of School, Other School Characteristics and Technology		
	<i>b</i>	<i>Beta</i>	<i>p</i>	<i>b</i>	<i>Beta</i>	<i>p</i>	<i>b</i>	<i>Beta</i>	<i>p</i>
Size	.006	.079	.015*	.036	.505	<.001*	.035	.486	<.001*
Minority				-.020	-.248	<.001*	-.021	-.262	<.001*
Econ. Disadvantaged				-.059	-.602	<.001*	-.058	-.590	<.001*
PPE				.002	.083	.009*	.001	.079	.013*
Integration							2.043	.077	.019*
Preparation/Develop.							.186	.008	.799
Infrastructure							-.353	-.015	.609
Number of Computers							.006	.024	.470
		$R^2 = .006$			$R^2 = .406$			$R^2 = .413$	
		$F = 5.936$			$F = 160.767$			$F = 82.253$	
		$p = .015*$			$p = <.001*$			$p = <.001*$	

*Significant at the .05 probability level

Table 10 displays the implications of the predictor variables on the advanced proficiency levels of fifth-grade students in the subject of math. The second step of the regression model examined the size of school and other school characteristics that accounted for 47.0% of the variance in advanced proficiency math scores for fifth graders. Of those predictor variables, the size of the school, number of minority students, and number of economically disadvantaged students all exhibited significant p values. The positive Beta for size of school was indicative of a moderately positive relationship between the number of students and advanced proficiency levels. A weak negative relationship existed between the number of minority students and advanced proficiency levels. A moderately strong negative relationship existed between the number of economically disadvantaged students and proficiency levels.

When the technology related predictor variables were examined in step three of the regression model, there was only a small jump in the explanation of variance from 47.0% to 47.5%. A difference of only .005 in the R^2 value between the second and final step indicated that the technology related factors accounted for only a miniscule difference in recorded proficiency levels for fifth graders in the subject of math. Of the variables examined, the size of school, number of minority students, and number of economically disadvantaged students retained significant p values and similar relationships in the third step.

Table 10

Hierarchical Multiple Regression Analysis of the Effects of School Size, Other School Characteristics, and Technology on Grade Five Math Advanced Proficiency

	Size of School			Size of School and Other School Characteristics			Size of School, Other School Characteristics and Technology		
	<i>b</i>	<i>Beta</i>	<i>p</i>	<i>b</i>	<i>Beta</i>	<i>p</i>	<i>b</i>	<i>Beta</i>	<i>p</i>
Size	.004	.062	.069	.039	.534	<.001*	.038	.526	<.001*
Minority				-.023	-.279	<.001*	-.023	-.285	<.001*
Econ. Disadvantaged				-.064	-.639	<.001*	-.063	-.628	<.001*

Results of Hypotheses Testing

Because the null hypotheses were shaped in summary format, the possibility existed that a single hypothesis might be rejected under certain circumstances for one part while being retained for another part.

H0₁ There is no relationship between the proportion of economically disadvantaged students or the district's per-pupil expenditure and level of technology integration.

No relationship could be inferred between the levels of technology integration and the proportion of economically disadvantaged students in a school's population. Therefore, null hypothesis 1 was retained in regards to the relationship between the levels of technology integration and the proportion of economically disadvantaged students.

However, a weak positive relationship did exist between the levels of technology integration and the district's per-pupil expenditure. Therefore, null hypothesis 1 was rejected in that regard.

H0₂ There is no relationship between the proportion of economically disadvantaged students or the district's per-pupil expenditure and level of professional development.

No relationship was found to exist between the proportions of economically disadvantaged students and the perceived level of professional development in instructional technology. Therefore, null hypothesis 2 was retained in regard to such a relationship.

A weak positive relationship did exist between per-pupil expenditure and the perceived level of technology-related professional development. Therefore, null hypothesis 2 was rejected in those regards.

H0₃ There is no relationship between the proportion of economically disadvantaged students or the district's per-pupil expenditure and level of technology infrastructure.

No relationship could be inferred between infrastructure and proportion of economically disadvantaged students. In addition, no relationship could be inferred between a school's

technology infrastructure and a district's per-pupil expenditure. Therefore, null hypothesis 3 was retained.

H0₄ There is no relationship between the size of the school and third and fifth graders' proficiency in reading and math.

After controlling for other school and technology factors, it was evident that there was a moderately positive relationship between the size of a school and the advanced proficiency level of third and fifth graders in both math and reading. Therefore, null hypothesis 4 was rejected.

H0₅ There is no relationship between the number of minority students and third and fifth graders' proficiency in reading and math.

In the third step of each regression model, there was a weak negative relationship between the number of minority students and the advanced proficiency levels of third and fifth graders in both subject areas. Because of this weak relationship, null hypothesis 5 was rejected.

H0₆ There is no relationship between the number of economically disadvantaged students and third and fifth graders' proficiency in reading and math.

At both grade levels and in both subject areas, the economically disadvantaged predictor variable accounted for the largest percentage of variance in the dependent variable. Furthermore, the relationship was of a negative nature. Null hypothesis 6 was rejected.

H0₇ There is no relationship between the per-pupil expenditure and third and fifth graders' proficiency in reading and math.

The per-pupil expenditure predictor variable was not statistically significant for either third or fifth graders' advanced proficiency levels in math. For that reason, the null hypothesis was retained for those grade levels in the subject of math. However, the null hypothesis was rejected for both grade levels in the subject of reading. While the *p* value was significant at both grade levels in the subject area of reading, the corresponding Beta scores were sufficiently low to conclude that there was only a very weak relationship between per-pupil expenditure and advanced proficiency levels in reading at both grade levels.

H0₈ There is no relationship between the level of technological integration and third and fifth graders' proficiency in reading and math.

If the p value were considered in isolation, the null hypothesis would be rejected for third-grade math and reading. However, with Betas of .072 and .077 respectively, the relationship between the level of technology integration and advanced proficiency levels of third graders in math and reading was extremely weak. There was not a significant relationship between the level of technology integration and the percentage of fifth graders' obtaining the advanced proficiency level in math and reading. Therefore, the null hypothesis was retained for fifth graders in both subject areas.

H0₉ There is no relationship between the level of educator preparation and professional development and third and fifth graders' proficiency in reading and math.

The level of educator preparation and professional development in instructional technology as reported through the E-TOTE survey instrument did not account for a significant percentage of the variance in the dependent variable at either grade or subject area. Null hypothesis 9 was retained.

H0₁₀ There is no relationship between infrastructure for technology and third and fifth graders' proficiency in reading and math.

The infrastructure predictor was considered significant on the regression models for fifth-grade advanced proficiency levels in reading only. However, with a Beta of .059, the relationship was considered extremely weak. Therefore, the null hypothesis was rejected for fifth graders in the subject of reading only. It was retained for third-grade math, third-grade reading, and fifth-grade math.

H0₁₁ There is no relationship between the percentage of mid- and high-capacity computers and third and fifth graders' proficiency in reading and math.

The number of mid- and high-capacity computers did not account for a significant percentage of the variance in the dependent variable at either grade or subject area. Null hypothesis 11 was retained.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

No one disputes that much time, money, and effort has been invested to increase the amount of technology available in schools today. In the *No Child Left Behind* legislation, the creation of a mechanism designed to earmark money specifically for educational technology for school districts is an indicator that many consider that technology holds the key to improved learning by students. This same legislation also goes farther than previous legislative acts by mandating that programs be scientifically based and calling for increased accountability including additional standardized testing.

The state of Tennessee chose to meet accountability requirements in a couple of different ways. Unlike some states, rather than adding questions dealing with technology to standardized tests, the Tennessee Department of Education chose to set up an online evaluation system, called E-TOTE (EdTech, 2002) that was designed to survey school stakeholders about several educational technology factors including questions about levels of technology integration, educators' preparation and development, administration and support services, infrastructure for technology, and equipment counts. To meet other testing mandates enacted through the *No Child Left Behind* legislation, the state of Tennessee also added a criterion-referenced portion to the otherwise norm-referenced standardized tests given at the third-, fifth-, and eighth-grade levels. These criterion-referenced questions were designed to assess the proficiency levels of students in the subjects of math and reading.

This study focused on those schools with either third- or fifth-grade criterion-referenced scores in math and reading. A decision was made to not include schools with eighth grades considering that those schools, most often middle schools, would be very dissimilar to the mostly elementary schools that contained third and fifth grades. The purpose of the study was to

describe several factors associated with educational technology based upon the E-TOTE survey answers. Additionally, the study sought to determine what relationships, if any, existed between technological characteristics of schools and the advanced proficiency levels of third and fifth graders in math and reading as denoted by criterion-referenced scores.

Summary of Findings

In the state of Tennessee, 1,066 schools met the criteria for having submitted E-TOTE surveys and having a third grade, fifth grade, or both grades. The E-TOTE surveys were limited to one per school. The principal at each school was responsible for getting the survey submitted online; however, personnel from the state department of education suggested that a designee of the principal might collect and submit the actual information. Principals were urged to neither over- or under-estimate answers and to verify data before the final submission. Instructions on the survey instructed those submitting answers to select the one indicator for each question that best described the campus. The researcher chose representative questions from the categories under investigation to analyze. This decision was made based on the investigator's belief that some of the questions were a bit more quantifiable on a school-wide basis than others when considering that the survey was likely completed by a single person making estimations.

Research Question #1

To what extent were educators integrating technology into instruction, and did this usage seem to be related to the socioeconomic status of the school's population or the district's per-pupil expenditure?

The phrasing of research question #1 shows a duality of purpose. On the one hand, the investigator desired to examine the available survey data to help explain how much teachers depended upon and used technology for teaching and learning. The investigator was also interested to see if teachers might tend to use technology to a greater extent with students who

were already familiar with the basic operation of technology. The assumption made by the investigator was that schools with a higher percentage of students of elevated socioeconomic status would be more likely to have had exposure to computers and productivity software at home than schools with higher percentages of economically disadvantaged students.

According to the E-TOTE survey data, teachers in relatively few schools responded that technology had greatly impacted their roles or collaborative learning. Whereas the largest percentage of surveys (46.5%) indicated that learning was still teacher-directed with students using technology for cooperative projects in their own classrooms a large percentage (44.4%) admitted that lectures were teacher-centered with students using technology to work on individual projects.

Overall, many school faculties (27.3%) used technology only as a supplement to traditional practices. The E-TOTE surveys (38.2%) reported that teachers were most likely to use technology to streamline administrative functions. Almost a third (32.3%) did aspire to use technology for research, lesson planning, multimedia and graphical presentations and simulations, and to correspond with experts, peers, and parents. A small percentage (2.3%) of schools reported that overall patterns of teacher use included the integration of evolving technologies necessary to transform the teaching process by allowing for greater levels of interest, inquiry, analysis, collaboration, creativity, and content production.

When asked to choose a statement characterizing where and when digital content is used, almost a fifth of the E-TOTE survey answers (19.2%) were that students received occasional computer use in the library or computer lab. A number of respondents (38.6%) said that students were offered regular weekly computer use to supplement classroom instruction primarily in lab and library settings. A number close to that amount (38.3%) said that students accessed EdTechnology regularly on a weekly basis for integrated curriculum activities in various instructional settings. Few school surveys (3.9%) claimed to have on-demand access to technologies intended for the purpose of seamlessly integrating core curriculum areas.

No relationship was found between the levels of technology integration of a school as reported through the E-TOTE survey and the socioeconomic status of the school's population. However, a weak positive relationship was found to exist between the district's per-pupil expenditure level and the level of technology integration.

Research Question #2

How did educators perceive their levels of professional development in instructional technology, and did this seem to be related to the socioeconomic status of the school's population or the district's per-pupil expenditure?

As noted in the literature review, one of the contributing factors associated with the, as of yet, mostly unrealized potential of technology may be a general lack of training. The investigator analyzed survey data to describe how faculty members at the selected schools perceived their readiness to use instructional technology. A second part of this question also presupposed that districts with greater financial resources as denoted by the reported per-pupil expenditure amount might be able to offer a higher level of professional development in using instructional technology than districts with lower per-pupil expenditure amounts.

One question asked on the E-TOTE survey inquired as to what models of professional development were used most often for technology-related training. Exactly a quarter of the respondents noted that most often the model of whole group instruction was used. Over a third (35.2%) said that while the model was a whole group setting, follow-up activities were provided to facilitate implementation. Almost as many (35%) selected the response denoting a long-term ongoing professional development and improvement process. Only 51 schools (4.8%) submitted surveys alluding that their professional development model involved the creation of learning communities featuring anytime learning available through a variety of delivery systems and offering individually guided activities.

The Apple Classrooms of Tomorrow's (ACOT) research highlighted five stages of development through which teachers must progress before they can use technology to its full potential (Sandholtz, Ringstaff, & Dwyer, 1997). In the order of instructional evolution, these stages include entry, adoption, adaptation, appropriation, and invention. Responses to the E-TOTE survey indicated that almost a third (32.6%) of faculty members rated themselves at the entry or adoption stage of understanding as denoted by students learning to use technology and teachers only using technology to support traditional instruction. The largest percentage of survey responses (48.3%) professed that teachers were at the adaptation stage as characterized by the use of technology to enrich the curriculum. Only 171 of the 1,066 schools (16.0%) reported that faculty members had progressed to the appropriation stage of understanding indicating technology integration was used for its unique capabilities. A very small percentage (3.1%) rated themselves as reaching the highest level of understanding, the invention stage, where teachers discovered and accepted new uses for technology.

Although no relationship was found to exist between the perceived level of technology-related professional development and the socioeconomic status of the school's population, a very weak positive relationship did exist between the perceived level of technology-related professional development and the school district's per-pupil expenditure.

Research Question #3

What was the infrastructure for technology, and did this seem to be related to the socioeconomic status of the school's population or the district's per-pupil expenditure?

This study analyzed two E-TOTE survey questions to ascertain if the push to plug-in, as alluded to in the literature review, was being realized throughout these Tennessee schools. The results indicated that more schools had advanced network capacities than sufficient computers to take advantage of those capacities. A large portion of the respondents (40.2%) found themselves at the unenviable level of having 10 or more students per Internet-connected multimedia

computer with a replacement cycle of six years or more. A greater percentage (43.2%) fared a bit better by responding that their schools had between five and nine students for every Internet-connected multimedia computer with a refresh cycle of every five years. A much smaller percentage (14.6%) of the respondents were able to have an Internet-connected multimedia computer for every 4 or less students, even with a refresh cycle of every 4 years. Only 21 respondents (2.0%) were able to claim that they could provide an Internet-connected multimedia computer for every four or fewer students to provide on-demand access with a replacement cycle of three years or fewer than three years.

The survey results were more encouraging in regard to the state of the schools' local and wide area networks. Although 188 respondents (17.6%) could only claim to have limited print/file-sharing networks, over a fifth (21.8%) said that most of the rooms were connected to the local area or wide area network (LAN/WAN) with high-end servers in use. Over half of the surveys analyzed (54.6%) maintained that all rooms were connected to the LAN/WAN via a switched network, which utilized high-end servers for multiple applications. The top echelon of network infrastructure consisting of a 100MB/GB fiber-switched network and including some wireless connectivity capable of doing video streaming or videoconferencing was attained by only 64 schools (6.0%).

No relationship existed between a school's infrastructure for technology and the socioeconomic status of the school's population. Additionally, no relationship existed between a school's infrastructure for technology and the district's published per-pupil expenditure rate perhaps confirming that the push to plug-in as managed through programs such as E-Rate has been very successful.

Research Question #4

What relationships, if any, existed between the technological characteristics of Tennessee schools and the advanced proficiency levels of third and fifth graders in math and reading?

I felt obligated to first examine a number of school characteristics not related to technology to help explain possible variances in the percentage of students attaining advanced proficiency levels. These characteristics included the size of the school as reported by the number of students attending when the criterion-referenced test was given, the number of minority students, the number of students classified as economically disadvantaged, and the per-pupil expenditure. Once these factors were accounted for in the regression models, no relationships were found to exist between any of the technological characteristics of the studied schools and the advanced proficiency levels of either third or fifth graders in the subjects of math or reading. The EdTechnological characteristics included the levels of technology integration, levels of preparation and development, infrastructure for technology, and number of mid- to high-capacity computers as reported through the E-TOTE survey.

Conclusions

Most faculty members in the schools examined in this study said they did not believe that technology was making a big impact on teachers' roles or collaborative learning levels. Supporting that supposition was the fact that very few schools reported that the majority of their faculty members were integrating technology to the point of transforming the teaching process. That is not to say teachers were not using the technology that was available. Within libraries, computer labs, and classrooms, the bulk of teachers did use technology for tasks ranging from basic curriculum supplementation to administrative functions and even for research, planning, presenting, and communicating with experts, peers, and parents.

Confirming some of the assertions made by authors cited in the literature review, Tennessee districts may not be leveraging the potential instructional technology holds because of inadequate professional development models that left teachers reportedly unprepared to fully integrate technology. Fewer than 5% of the surveyed schools analyzed in this study endeavored to create learning communities of inquiry and knowledge building for technology-related

activities. That may explain why an even smaller percentage of schools claimed that faculty members had attained the highest level of understanding related to technology use.

Most schools had a reasonably good network infrastructure but displayed the tendency to have older computers attached to the network. The vast majority of schools (83.4%) reported a refresh cycle no sooner than every five years and having only one Internet-connected multimedia computer available for every five or substantially more students. Considering the relatively high student to computer ratio and the fact that many students were using out-dated EdTechnology, the case could be made that students were not getting enough exposure to high-quality technology to show positive results. Similar findings were made by researchers who took snapshot surveys of technology in kindergarten through 12th-grade classrooms in both large and small districts throughout the country (Norris, Sullivan, Poirot, & Soloway, 2003).

No relationships were found to exist between various technological characteristics reported through the E-TOTE survey instrument and advanced proficiency levels of third or fifth graders in either math or reading. Though disappointing to the investigator of this study, the lack of a positive relationship between any of the technological characteristics examined and advanced proficiency scores might be indicative of phenomena explored in the literature review. The assessment tool of a criterion-referenced test in math and reading might have been poorly constructed to measure the extent that technology was able to foster independent thinking and active learning (Benton Foundation, 2003; Roschelle et al., 2002; Weaver, 2000). Furthermore, as noted by Reeves (2002), principals might not have pushed for technology-based activities that stressed higher-order thinking skills because they considered those types of activities did not align very well with questions presented on the high-stakes TCAP test. The NetDay (2001) survey that reported only 10% of teachers reporting they felt pressure from their principals to use the Internet would seem to support such a possibility.

Recommendations

Because the first three research questions served to simply describe the state of technology characteristics in Tennessee, they were of limited value in making recommendations to improve practice especially when considering that no relationships were found to exist between those characteristics and advanced proficiency scores. However, several recommendations can be formulated to increase the value of future research.

1. The State Department of Education should consider asking every classroom teacher to submit answers to the E-TOTE survey. By doing so, the collected survey data could be of much higher quality because it would not embody a single selection representative of the entire faculty's collective responses. This would also make it possible to do research based upon information reported by various subgroups.
2. The State Department of Education should consider refining E-TOTE questions to evaluate only single items of information. For example, one of the questions evaluated in this study inquired about both the number of students per computer and the refresh cycle. By combining these items, it would have been impossible for a school to report a ratio of four or fewer students per Internet-connected multimedia computer and a replacement cycle of every six or more years.
3. The State Department of Education should consider adding a "None" or "N/A" answer to many of the E-TOTE questions especially if individual teachers are allowed to submit survey responses. For example, the question about patterns of teacher use of technology lists "uses technology as a supplement" as the lowest possible pattern of use when some teachers may not use technology at all.
4. The State Department of Education should consider using the available data, including that collected through the course of this study, to analyze differences between individual school districts.

5. School districts should consider using the available data including those collected through the course of this study to analyze differences among individual schools within the district. Future studies should re-evaluate the relationships between technological characteristics and test results after incorporating a test designed to measure the reasoning abilities of children.
6. Future studies should correlate results of a test designed to measure the reasoning abilities of children to the amount of principal support for technology integration.

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APPENDIX
E-TOTE Survey



OnTarget
EdTech Tennessee Online Technology Evaluation System

E-TOTE

<http://tn.ontargetus.com>

Tennessee DISTRICT Account Profile Information

1. Please provide, verify and/or amend the following general information about your district in each text box.	
District:	
Street:	
City:	
State:	
Zip:	
Phone:	
Fax:	
Technology Coordinator's Name	
Technology Coordinator's Email	

2. Is the "technology coordinator" position a full-time technology position?

Yes

No

3. Network and Internet Access	
<input type="checkbox"/>	System relies totally on the ConnectTEN internet backbone to carry internet to each school building
<input type="checkbox"/>	System relies only on the ConnectTEN internet backbone to carry internet to a single egress point
<input type="checkbox"/>	System does not utilize the ConnectTEN internet backbone

Technology Support

1. Although some technical support and training may be provided at schools by teachers receiving an additional stipend, exclude these from your answer to these questions. (You may include the technology coordinator(s) in these counts.)

Number of technology technicians on district payroll (in full-time equivalents)	
Number of technology integration trainers on district payroll (in full-time equivalents)	

Web Presence

1. What is the URL for your district home page ?

2. Does your district have a district web master?

- Yes, full-time
- Yes, only part-time
- No, but we subcontract out the web design work
- No

3a. Does your district have its own web server?

- Yes
- No

3b. If yes, does, or will your district web server host pages for individual schools within your system?

- Yes
- No

Email

1. What kind of email service is available to your teachers and administrators?

- State email network (Ten-Nash)
- District email server
- Both

2. What is your district policy regarding student email accounts?

- Not allowed to use email at school
- Is provided by the district email system
- Students permitted to use free Web based email

Tennessee School Account Profile Information

Account Profile

Please provide, verify and/or amend the following general information about your school in each text box.	
District Name:	
District Number:	
School Name:	
School Number:	
Street:	
City:	
State:	
Zip:	
Phone:	
Fax:	
Principal's Name	
Principal's Email	
School Web Site	
Person Completing Survey:	
Name:	
Position:	
Email:	

Profile Information

1.1 School Information

1. Please type in the total numbers within your school for the following. (A "computer lab" is a schoolroom having 10 or more stationary computers. The room is available for student or rotating class but is not assigned as a regular classroom on your school schedule. It is not the library, although it may be adjacent to the library.)

Students:	
Teachers:	
Classrooms:	
Computer Labs:	

2. What grades are taught at this school? (Check all that apply)

<input type="checkbox"/> PK	<input type="checkbox"/> 4	<input type="checkbox"/> 9
<input type="checkbox"/> K	<input type="checkbox"/> 5	<input type="checkbox"/> 10
<input type="checkbox"/> 1	<input type="checkbox"/> 6	<input type="checkbox"/> 11
<input type="checkbox"/> 2	<input type="checkbox"/> 7	<input type="checkbox"/> 12
<input type="checkbox"/> 3	<input type="checkbox"/> 8	<input type="checkbox"/> Ungraded

1.2 Special Program Information

If applicable, indicate special programs in your school that may impact this technology data.

- Vocational Education
 - Special Education
 - Alternative Education
 - Grants
 - Title I school or receives Title I targeted assistance
 - No Special Programs
 - Other (Specify)
-

Tennessee STaR Chart

For each of the four key areas in the STaR Chart, a series of 5-6 indicators is provided for you to use to indicate your school's Level of Progress (1-4). It is possible that your school may have indicators in more than one Level of Progress. However, select the one Level of Progress that best describes your campus for each indicator.

2.1 Teaching and Learning

A. Impact of Technology on Teacher Role and Collaborative Learning.(select the best description)

<input type="checkbox"/>	1. Teacher-centered lectures. Students use technology to work on individual projects.
<input type="checkbox"/>	2. Teacher-directed learning. Students use technology for cooperative projects in their own classroom
<input type="checkbox"/>	3. Teacher facilitated learning. Students use technology to create communities of inquiry within their own community
<input type="checkbox"/>	4. Teacher as facilitator, mentor, and co-learner. Student-centered learning, teacher as mentor/facilitator with national /international business, industry, university communities of learning

B. Patterns of Teacher Use of Technology (select the best description)

<input type="checkbox"/>	1. Use technology as a supplement.
<input type="checkbox"/>	2. Use technology to streamline administrative functions (i.e., gradebook, attendance, word processing, E-mail, etc.)
<input type="checkbox"/>	3. Use technology for research, lesson planning, multimedia and graphical presentations and simulations, and to correspond with experts, peers, and parents
<input type="checkbox"/>	4. Integration of evolving technologies transforms the teaching process by allowing for greater levels of interest, inquiry, analysis, collaboration, creativity and content production

C. Frequency/ Design of Instructional Setting Using Digital Content (select the best description)

<input type="checkbox"/>	1. Occasional computer use in library or computer lab setting
<input type="checkbox"/>	2. Regular weekly computer use to supplement classroom instruction, primarily in lab and library settings
<input type="checkbox"/>	3. Regular weekly technology use for integrated curriculum activities utilizing various instructional settings (i.e., classroom computers, libraries, labs, and portable technologies)
<input type="checkbox"/>	4. Students have on-demand access to all appropriate technologies to complete activities that have been seamlessly integrated into all core curriculum areas

D. Curriculum Areas (select the best description)

<input type="checkbox"/>	1. No technology use or integration occurring in the core curriculum subject areas
<input type="checkbox"/>	2. Use of technology is minimal in core curriculum subject areas
<input type="checkbox"/>	3. Technology is integrated into core subject areas, and activities are separated by subject and grade
<input type="checkbox"/>	4. Technology is integral to all subject areas

E. Technology Applications Assessment. (select the best description)

<input type="checkbox"/>	1. Campuses that serve grades K-8: Within each grade level cluster (K-2, 3-5, 6-8), some but not all Technology standards are met. High School Campuses: At least 4 Technology Applications courses offered
<input type="checkbox"/>	2. Campuses that serve grades K-8: Within each grade level cluster (K-2, 3-5, 6-8), most Technology standards are met. High School Campuses: At least 4 Technology Applications courses offered and at least 2 taught
<input type="checkbox"/>	3. Campuses that serve grades K-8: Within each grade level cluster (K-2, 3-5, 6-8), all Technology standards are met. Grade-level benchmarks (K-8) are established. High School Campuses: At least 4 Technology Applications courses offered and at least 4 taught
<input type="checkbox"/>	4. Campuses that serve grades K-8: Within each grade level cluster (K-2, 3-5, 6-8), all Technology standards are met. Grade-level benchmarks (K-8) are met. High School Campuses: All Technology Applications courses offered with a minimum of 4 taught, or included as new courses developed as local elective or included as independent study course

F. Patterns of Student Use of Technology.(select the best description)

<input type="checkbox"/>	1. Students occasionally use software applications and/or use tutorial software for drill and practice
<input type="checkbox"/>	2. Students regularly use technology on an individual basis to access electronic information and for communication and presentation projects
<input type="checkbox"/>	3. Students work with peers and experts to evaluate information, analyze data and content in order to problem solve. Students select appropriate technology tools to convey knowledge and skills learned
<input type="checkbox"/>	4. Students work collaboratively in communities of inquiry to propose, assess, and implement solutions to real world problems. Students communicate effectively with a variety of audiences

2.2 Educator Preparation and Development

G. Content of Training.(select the best description)

<input type="checkbox"/>	1.	Technology literacy skills including multimedia and the Internet
<input type="checkbox"/>	2.	Use of technology in administrative tasks and classroom management; use of Internet curriculum resources
<input type="checkbox"/>	3.	Integration of technology into teaching and learning; regularly uses internet curriculum resources to enrich instruction
<input type="checkbox"/>	4.	Regular creation and communication of new technology-supported, learner-centered projects; vertical alignment of all Technology Application curriculum standards; anytime anywhere use of Internet curriculum resources by entire school community.

H. Capabilities of Educators.(select the best description)

<input type="checkbox"/>	1.	10% meet ISTE technology proficiencies and implement in the classroom
<input type="checkbox"/>	2.	40% meet ISTE technology proficiencies and implement in the classroom
<input type="checkbox"/>	3.	60% meet ISTE technology proficiencies and implement in the classroom
<input type="checkbox"/>	4.	100% meet ISTE technology proficiencies and implement in the classroom

I. Leadership Capabilities of Administrators.(select the best description)

<input type="checkbox"/>	1.	Recognizes benefits of technology in instruction; minimal personal use
<input type="checkbox"/>	2.	Expects teachers to use technology for administrative and classroom management tasks; uses technology in some aspects of daily work
<input type="checkbox"/>	3.	Recognizes and identifies exemplary use of technology in instruction; models use of technology in daily work
<input type="checkbox"/>	4.	Ensures integration of appropriate technologies to maximize learning and teaching; involves and educates the school community around issues of technology integration

J. Models of Professional Development.(select the best description)

<input type="checkbox"/>	1.	Whole group
<input type="checkbox"/>	2.	Whole group, with follow-up to facilitate implementation
<input type="checkbox"/>	3.	Long term and ongoing professional development; involvement in a developmental/ improvement process
<input type="checkbox"/>	4.	Creates communities of inquiry and knowledge building; anytime learning available through a variety of delivery systems; individually guided activities

K. Levels of Understanding and Patterns of Use.(select the best description)

<input type="checkbox"/>	1.	Most at entry or adoption stage (Students learning to use technology; teachers use technology to support traditional instruction)
<input type="checkbox"/>	2.	Most at adaptation stage (Technology used to enrich curriculum; Most beginning to use with students)
<input type="checkbox"/>	3.	Most at appropriation stage (Technology is integrated, used for its unique capabilities)
<input type="checkbox"/>	4.	Most at invention stage (Teachers discover and accept new uses for technology)

L. Technology Budget Allocated to Technology Professional Development.(select the best description)

<input type="checkbox"/>	1.	5% or less
<input type="checkbox"/>	2.	6-24%
<input type="checkbox"/>	3.	25-29%
<input type="checkbox"/>	4.	30% or more

2.3 Administration and Support Services

M. Vision and Planning.(select the best description)

<input type="checkbox"/>	1.	No campus technology plan; technology used mainly for administrative tasks such as word processing, budgeting, attendance, gradebooks
<input type="checkbox"/>	2.	Campus technology plan aligns with the TN Long Range Technology Plan; integrated into district plan; used for internal planning, budgeting, and applying for external funding and discounts. Teachers/administrators have a vision for technology use for direct instruction and some student use
<input type="checkbox"/>	3.	In addition to the above, the campus technology plan is approved by the board and supported by Director of Schools. Campus plan collaboratively developed, guiding policy and practice; regularly updated. Campus plan addresses technology application essential knowledge and skills and higher order teaching and learning. Administrators use technology tools for planning
<input type="checkbox"/>	4.	In addition to the above, the campus technology plan is actively supported by the board. Campus plan is collaboratively developed, guiding policy and practice; updated at least annually. The campus plan is focused on student success; based on needs, research, proven teaching and learning principles. Administrators use technology tools for planning and decision making

N. Technical Support.(select the best description)

<input type="checkbox"/>	1.	No technical support on-site; technical support call-in; response time greater than 24 hours
<input type="checkbox"/>	2.	At least one technical staff to 750 computers. Centrally deployed technical support call-in; response time less than 24 hours
<input type="checkbox"/>	3.	At least one technical staff to 500 computers. Central technology support using remote management software tools. Centrally deployed and minimal campus-based technical support on-site; response time is less than 8 hours
<input type="checkbox"/>	4.	At least one technical staff to 350 computers; centrally deployed and dedicated campus-based. Central technology support use remote management software tools. Technical support on-site; response time is less than 4 hours

O. Instructional and Administrative Staffing.(select the best description)

<input type="checkbox"/>	1.	No full time dedicated district level Technology Coordinator. Campus educator serving as local technical support
<input type="checkbox"/>	2.	Full-time district level Technology Coordinator/Assistant Superintendent for Technology. Centrally located instructional technology staff; one for every 5,000 students. Additional staff as needed, such as trainer, webmaster, network administrator
<input type="checkbox"/>	3.	Full-time district level Technology Coordinator/Assistant Superintendent for Technology. Centrally located instructional technology staff; one for every 1,000 students. Additional staff as needed
<input type="checkbox"/>	4.	Full-time district level Technology Coordinator/Assistant Superintendent for Technology. Dedicated campus-based instructional technology support staff-one per campus plus one for every 1,000 students. Additional staff as needed

P. Budget.(select the best description of how your school spends its technology budget)

<input type="checkbox"/>	1.	Campus budget for hardware and software purchases and professional development
<input type="checkbox"/>	2.	Campus budget for hardware and software purchases and professional development, minimal staffing support, and some ongoing costs
<input type="checkbox"/>	3.	Campus budget for hardware and software purchases and professional development, adequate staffing support, and ongoing costs
<input type="checkbox"/>	4.	Campus budget for hardware and software purchases, sufficient staffing support, costs for professional development, facilities and other ongoing costs. Appropriate budget to support the district technology plan

Q. Funding.(select the best description of the source of your school technology funding)

<input type="checkbox"/>	1.	Local fundraisers only
<input type="checkbox"/>	2.	Fundraisers and minimum grants/minimal local funding
<input type="checkbox"/>	3.	Grants, E-Rate discounts applied to technology budget, locally supplemented through tax dollars
<input type="checkbox"/>	4.	Other competitive grants, E-Rate discounts, locally supplemented through tax dollars. Other state and federal programs directed to support technology funding, bond funds, business partnerships, donations, foundations, and other local funds designated for technology

2.4 Infrastructure for Technology

R. Students per Computer.(select the best description)

<input type="checkbox"/>	1.	Ten or more students per Internet-connected multimedia computer. Refresh cycle established by district/campus for every 6 or more years
<input type="checkbox"/>	2.	Between 5 and 9 students per Internet-connected multimedia computer. Refresh cycle established by district/campus is every 5 years
<input type="checkbox"/>	3.	Four or less students per Internet-connected multimedia computer. Replacement cycle established by district/campus is every 4 years
<input type="checkbox"/>	4.	In addition to 4 or less students per Internet-connected multimedia computer, on-demand access for every student. Replacement cycle established by district/campus is 3 or less years

S. Internet Access Connectivity/Speed.(select the best description)

<input type="checkbox"/>	1.	Dial-up connectivity to the Internet available only on a few computers
<input type="checkbox"/>	2.	Direct connectivity to the Internet available at the campus in 50% of the rooms, including the library. Adequate bandwidth to the campus to avoid most delays
<input type="checkbox"/>	3.	Direct connectivity to the Internet in 75% of the rooms, including the library. Adequate bandwidth to each classroom over the local area network (at least 10/100 MB LAN) to avoid most delays. Easy access for students and teachers
<input type="checkbox"/>	4.	Direct connectivity to the Internet in all rooms on all campuses. Adequate bandwidth to each classroom over the local area network (at least 100 MB or fiber network LAN). Easy access for students and teachers including some wireless connectivity

T. Distance Learning. (select the best description)

<input type="checkbox"/>	1. No Web based/online learning available at the campus. No satellite based learning available at the campus. No two-way interactive video distance learning capabilities available at the campus
<input type="checkbox"/>	2. Web-based/on-line learning available at the campus. Satellite based learning available at the campus. No two-way interactive video distance learning capabilities available at the campus, but available in the district
<input type="checkbox"/>	3. Web-based/on-line learning available at the campus. Satellite-based learning available at the campus. Two-way interactive video distance learning capabilities available in at least one classroom
<input type="checkbox"/>	4. Web-based/on-line learning available at the campus. Satellite-based learning available at the campus. Two-way interactive video distance learning capabilities available at the campus in multiple classrooms

U. LAN/WAN. (select the best description)

<input type="checkbox"/>	1. Limited print/file sharing network at the campus. Some shared resources available on the campus LAN
<input type="checkbox"/>	2. Most rooms connected to the LAN/WAN with student access. Minimum 10/100 Cat 5 hubbed network. High-end servers, such as Novell or NT servers, serving some applications
<input type="checkbox"/>	3. All rooms connected to the LAN/WAN with student access. Minimum 10/100 Cat 5 switched network. High-end servers, such as Novell or NT servers, serving multiple applications
<input type="checkbox"/>	4. All rooms connected to the WAN sharing multiple district-wide resources. Campus is connected to robust WAN with 100 MB/GB and/or fiber switched network that allows for resources such as, but not limited to, video streaming and desktop videoconferencing. Easy access to network resources for students and teachers, including some wireless connectivity

V. Other Technologies. (select the best description)

<input type="checkbox"/>	1. Shared use of resources such as, but not limited to, TVs, VCRs, digital cameras, scanners, classrooms sets of programmable calculators
<input type="checkbox"/>	2. One educator per computer. Shared use of resources such as TVs, VCRs, digital cameras, scanners, digital projectors, and analog video cameras; classrooms sets of programmable calculatorss
<input type="checkbox"/>	3. One educator per computer. Dedicated and assigned use of commonly used technologies such as computers with projection devices, TVs, VCRs, programmable calculators assigned to each student, and telephones in each classroom. Shared use of specialized technologies such as digital cameras, scanners, document cameras and projectors, and digital video cameras
<input type="checkbox"/>	4. One educator per computer. Fully equipped classrooms with all the technology that is available to enhance student instruction readily available including all of the above as well as the use of new and emerging technologies

Equipment Count

3.1 Computer Count

Using the definitions presented here, complete the table below for the number of computers of each type in each location.

Definitions	
High Capacity:	Pentium III (PCs) or Macintosh G4 or higher
Mid Capacity:	Pentium II or Macintosh G3
Low Capacity:	Thin Client, Pentium, 486 processors or 68040 processors (Macintosh, Centris, Quadra, LC475, LC575, LC 580) that are still in use

Type	Offices	Classrooms	Computer Labs	Library/Media Center	Mobile Computers (Laptops)
High Capacity					
Medium Capacity					
Low Capacity					

3.2 Classroom Computer Access

1. How many classrooms (not including labs or library media centers) have at least one mid- or high-capacity computer connected to the Internet for teacher use? (The computer may be for teacher use only or shared with students)
2. How many classrooms (not including labs or library media centers) have at least one mid- or high-capacity computer connected to the Internet available for student use? (The computer may be for student use only or shared with teacher. Be sure to include in this count any classrooms counted in the item above that have computers shared by teachers and students.)
3. How many classrooms (not including labs or library media centers) have at least 5 mid- or high-capacity computers connected to the Internet available for student use? (Be sure to include those counted in the item directly above.)
4. How many computers in all (in classrooms, labs, libraries, and offices) are connected to the Internet?

3.3 Computer Projection Devices

1. How many classrooms have a computer projection device or LCD Panel connected to an online computer?
2. How many classrooms have a TV of sufficient size for classroom viewing connected to an online computer?
3. How many classrooms have an interactive whiteboard connected to an online computer?
4. How many computer labs (not included in the classrooms reported above) have a computer projection device or LCD panel connected to an online computer?
5. How many computer labs (not included in the classrooms reported above) have a TV of sufficient size for classroom viewing connected to an online computer?
6. How many computer labs (not included in the classrooms reported above) have an interactive whiteboard connected to an online computer?
7. How many traveling computer projection devices do you have (not included in the counts above)?

3.4 Operating System

Which is the dominant Operating System on the classroom computers in your school?

- Macintosh
- Windows
- Both present, but Macintosh predominates
- Both present, but Windows predominates
- Other (Specify)

Network Access and Capabilities

4.1 Home School Communication

1. The following types of Home/School communication systems are in place for our school. (Check all that apply)

- Telephone Homework Hotline
- Voice Bulletins/Voice Mail
- School/District Website
- Email System
- Other (Specify):

4.2 Wireless/Laptop Computing

1. The following wireless or laptop computing resources are available in our school. (Check all that apply)

- Laptop computers primarily for administrative use
- Laptop computers primarily for teacher use
- Laptop computers primarily for student use
- Wireless laptop computing
- No wireless or laptop computing resources available

4.3 After Hours Technology Resources

1. What is the PRIMARY delivery resource available to students or community after school hours? (Choose one answer)

- Online Internet Resources
- Interactive Video Courses
- Teacher Led Courses
- No After Hours Resources Available
- Other (Specify):

2. Check any of the technology resources that are available for student or community use after school hours (Check all that apply)

- Computer Lab
- Library/Media Center
- Classrooms
- Interactive Video Classrooms
- Laptop Computers For Teacher Check-Out
- Laptop Computers For Student Check-Out
- No technology resources available after school hours
- Other (Specify):

4.4 Home Access to the Internet

1. What percent of the students in your school have access to the Internet in their homes?

%

2. How did you arrive at this percent? (choose one answer)

- Estimation
- Survey of Students
- Survey of Parents/Guardians
- Other (Specify)

3. What percent of the teachers/staff in your school have access to the Internet in their homes?

%

4. How did you arrive at this percent? (choose one answer)

- Estimation
- Survey of Teachers
- Other (Specify)

Student Technology Literacy

5.1 Whole-School Student Technology Literacy

Consider each of the technology literacy competencies (from ISTE NETS). What percent of all of the students in your school have demonstrated competence in each of the following competencies?

1. Applying strategies for identifying and solving routine hardware and software problems that occur during everyday use. (TN Standard 4) %
2. Demonstrating knowledge of current changes in information technologies and the effect those changes have on the workplace and society (TN Standard 1) %
3. Exhibiting legal and ethical behaviors when using information and technology, and discussing consequences of misuse (TN Standard 2) %
4. Using content-specific tools, software, and simulations (e.g., environmental probes, graphing calculators, exploratory environments, Web tools) to support learning and research (TN Standard 6) %
5. Applying productivity/multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum (TN Standard 5, 6) %
6. Designing, developing, publishing, and presenting products (e.g., Web pages, videotapes) using technology resources that demonstrate and communicate curriculum concepts to audiences inside and outside the classroom (TN Standard 7) %
7. Collaborating with peers, experts, and others using telecommunications and collaborative tools to investigate curriculum-related problems, issues, and information, and to develop solutions or products for audiences inside and outside the classroom (TN Standard 3) %
8. Selecting and using appropriate tools and technology resources to accomplish a variety of tasks and solve problems (TN Standard 5) %
9. Demonstrating an understanding of concepts underlying hardware, software, and connectivity, and of practical applications to learning and problem solving (TN Standard 4) %
10. Researching and evaluating the accuracy, relevancy, appropriateness, comprehensiveness, and bias of electronic information sources concerning real-world problems (TN Standard 2) %
11. For the answers provided about whole-school student technology literacy, what was the primary method you used to determine the percentages? (Choose one answer)

- No organized way to ascertain the information
- Estimates based on teacher informal reporting
- Student self-reported skills checklist
- Teacher informal observation using skills checklist
- Site-developed technology literacy test
- End-of-course test for technology application class
- Performance-based authentic assessment (portfolios)

5.2 Eighth Grade Student Technology Literacy

Note: This section applies only if your school has 8th graders according to the school information you provided in section 1.1.

What percent of all of the current eighth grade students in your school have demonstrated competence in each of the competencies.

- | | |
|--|---|
| 1. Applying strategies for identifying and solving routine hardware and software problems that occur during everyday use. (TN Standard 4) | % |
| 2. Demonstrating knowledge of current changes in information technologies and the effect those changes have on the workplace and society (TN Standard 1) | % |
| 3. Exhibiting legal and ethical behaviors when using information and technology, and discussing consequences of misuse (TN Standard 2) | % |
| 4. Using content-specific tools, software, and simulations (e.g., environmental probes, graphing calculators, exploratory environments, Web tools) to support learning and research (TN Standard 6) | % |
| 5. Applying productivity/multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum (TN Standard 5, 6) | % |
| 6. Designing, developing, publishing, and presenting products (e.g., Web pages, videotapes) using technology resources that demonstrate and communicate curriculum concepts to audiences inside and outside the classroom (TN Standard 7) | % |
| 7. Collaborating with peers, experts, and others using telecommunications and collaborative tools to investigate curriculum-related problems, issues, and information, and to develop solutions or products for audiences inside and outside the classroom (TN Standard 3) | % |
| 8. Selecting and using appropriate tools and technology resources to accomplish a variety of tasks and solve problems (TN Standard 5) | % |
| 9. Demonstrating an understanding of concepts underlying hardware, software, and connectivity, and of practical applications to learning and problem solving (TN Standard 4) | % |
| 10. Researching and evaluating the accuracy, relevancy, appropriateness, comprehensiveness, and bias of electronic information sources concerning real-world problems (TN Standard 2) | % |
| 11. For the answers provided about whole-school student technology literacy, what was the primary method you used to determine the percentages? (Choose one answer) | |
| <input type="radio"/> No organized way to ascertain the information | |
| <input type="radio"/> Estimates based on teacher informal reporting | |
| <input type="radio"/> Student self-reported skills checklist | |
| <input type="radio"/> Teacher informal observation using skills checklist | |
| <input type="radio"/> Site-developed technology literacy test | |
| <input type="radio"/> End-of-course test for technology application class | |
| <input type="radio"/> Performance-based authentic assessment (portfolios) | |

Assistive Technologies

6.1 Assistive Technologies

Is assistive technology (e.g. portable word processors and brailers, electronic communication aids for speech or computers with adaptive devices) used by students with disabilities or students with learning difficulties? (choose one answer)

<input type="checkbox"/>	Yes, for both students with disabilities who have an Individualized Education Plan or a 504 Plan and for students who experience difficulties learning but do not receive special education services or support through a 504 Plan
<input type="checkbox"/>	Yes, primarily for students with disabilities who have an Individualized Education Plan or a 504 Plan
<input type="checkbox"/>	No, most teachers are aware of these options but have not been trained how to support students who use the technology
<input type="checkbox"/>	No, most teachers are not aware of these options
<input type="checkbox"/>	No, there is not a clear process in place in our school for obtaining assistive technology
<input type="checkbox"/>	Other (Specify)

VITA

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Education:

Public Schools, Abingdon, Virginia

Virginia Highlands Community College, Abingdon, VA;
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1989

Emory & Henry College, Emory, VA;
Interdisciplinary English, B.A.;
1993

East Tennessee State University, Johnson City, Tennessee;
Educational Leadership and Policy Analysis, M.Ed.;
1997

East Tennessee State University, Johnson City, Tennessee;
Educational Leadership and Policy Analysis, Ed.D.;
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Professional
Experience:

Teacher, Bristol TN City Schools,
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1994-2000

Consulting Teacher for Curriculum/Technology, City Schools
Bristol, Tennessee;
2000-2002

Director of Technology , Bristol City Schools,
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