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The Integrated Studies of Educational Technology:
A Formative Evaluation of the E-Rate Program

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Contents

Exhibits

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All errors and conclusions are the sole the responsibility of the authors.

Executive Summary

The E-Rate program has allowed our district to provide the latest Internet connectivity for our students, as well as providing faster and more reliable internal connections. We are using equipment that would, under normal circumstances, be out of reach to a school district of our size.
Principal of a small rural school

The E-Rate Program

Although the United States is a leader of the technological revolution, there are segments of American society—particularly the poor, minorities, and the geographically isolated—for whom access to computers and the Internet is significantly lower. The E-Rate, created by Congress as part of the Telecommunications Act of 1996 (Public Law 104-104), is a federal program that seeks to bridge this "digital divide" by supporting broader public access to the new digital technology at public and private nonprofit educational institutions. The availability of such public access points has been found to reduce economic and racial disparities, and some research suggests that when used by trained and well-supported teachers, technology can improve learning, especially for disadvantaged children (Becker 2000). As two principals in this study observed, *"Technology is a vital part of our students' learning"* and *"The availability of computers and software is a must when we look at the demands on meeting academic standards."*

But modern digital technology can be expensive to acquire and can force educators to make difficult choices between investing in technology or in other strategies for improving student learning (e.g., teacher professional development, smaller classes, and better curriculum). Consequently, the E-Rate was designed to help schools and libraries gain needed access to the Internet and other digital technology while allowing them to use their scarce resources to support other critical aspects of educational reform. As one principal reported, *"This program has allowed us to have more and better communications equipment and greater, faster access to the Internet. It has freed funds for other activities that would not have been available."*

Schools and libraries approved for the E-Rate receive discounts—that is, they pay lower than market prices—on qualifying telecommunication equipment and services. The discounts range from 20 to 90 percent and are based on the percentage of students eligible for participation in the National School Lunch Program and whether the school or library is located in a rural area (where the cost of remote access is likely to be higher). Communities with higher concentrations of poor children and those located in rural areas receive higher discounts. The total amount of these discounts is, however, subject to an overall $2.25 billion annual program cap.

The E-Rate supports the acquisition of digital technology infrastructure, including telephone services (basic, long-distance, and wireless); Internet and web site services; and the acquisition and installation of network equipment and services, including wiring in school and library buildings. Other components of an educational technology system—including computer hardware and software, staff training, and electrical upgrades— are not covered under the E-Rate.

The Formative Evaluation of the E-Rate

This examination of the **first two years** of the E-Rate program (1998–99 and 1999–00) is part of the larger Integrated Studies of Educational Technology (ISET) that was designed to address a broad range of questions about the current use of technology in America's public schools. The U.S. Department of Education's Planning and Evaluation Service sponsored ISET, in collaboration with the Office of Elementary and Secondary Education, the Office of Educational Technology, and the Schools and Libraries Division of the Federal Communications Commission, which administers the E-Rate. In addition to this study of the E-Rate, ISET includes a study of the implementation of the Technology Literacy Challenge Fund (TLCF) and a study of technology-related professional development and teachers' use of educational technology. This report is based on an analysis of data from the linked ISET surveys, combined with data from E-Rate administrative records for the period ending January 2000.

Findings

Two main questions were the focus of this study: (1) To what extent is the E-Rate helping to equalize access to the types of digital technology eligible for program discounts? (2) Are schools and teachers able to use the technology that E-Rate supports? How is it being used in the classroom?

Is the E-Rate Helping to Equalize Access?

Computers and the Internet have become widely available in today's public schools, and most parents would be surprised not to see a computer in their child's classroom. In particular, once glaring differences in the availability of computers and the Internet between high- and low-poverty schools have all but disappeared. And, although classroom-level Internet access is still more common in wealthy schools, there have been increases in classroom access in the poorest schools since 1998, after a period of relative stagnation. The recent improvements coincided with the commitment of nearly $8 billion in E-Rate discounts to schools and libraries between 1998 and 2001.

> *The E-Rate has allowed the school district to put in place an infrastructure that has opened a huge number of opportunities to our students by accessing the Internet for research as well as video conferencing capabilities in each of our schools.*
>
> **Principal of a small rural school**

According to E-Rate administrative data, 84 percent of approved discounts have gone to public schools, and significantly higher discounts have been directed to poor and rural communities—per student funding for the most disadvantaged school districts was almost 10 times higher than for the least disadvantaged districts, and higher discounts have gone to the poorest rural communities. This targeting is especially important because, as found in this study, poorer schools that receive E-Rate discounts are less likely than their wealthier counterparts to have access to nongovernment sources of technology funds.

E-Rate applications covering the program's first two years (1998–99 and 1999–00) also indicate statistically significant increases in the availability of digital technology reported by E-Rate districts that received discounts in both years, including the fraction of schools and classrooms connected to the Internet, the speed of their Internet connections, and the number of Internet connections per student. Further, according to the ISET surveys, most students in E-Rate schools (80 percent) have teachers who have access to an e-mail account at their school, about two-thirds have teachers who can to access their school's computer network from home, and 57 percent have teachers who can also access the Internet this way.

State agencies have played an important role in helping to expand the availability of the Internet and other digital technologies, and such leadership is associated with a higher fraction of districts applying for, and receiving, E-Rate discounts. This leadership includes state investments in creating educational networks linking districts and schools; providing state regional technology assistance centers; finding ways to use other funds, such as the TLCF; creating purchasing consortia to help lower the cost of acquiring hardware and software; and providing state guidelines for the design of school technology-related facilities.

Are Schools Able to Use the Supported Technology?

Although public districts and schools, especially those in poor and rural communities, have been the primary beneficiaries of E-Rate support, significant gaps exist in their ability to make effective use of the acquired technology for classroom instruction:

- Students in **poorer E-Rate** districts and schools are—according to district and school administrators and teachers—more likely (controlling for other factors) to face a variety of conditions that may limit their use of technology for instruction, including inadequate teacher skills, limitations of existing school buildings (i.e., security, space, and electrical systems), and the speed and reliability of existing Internet connections.

- Similarly, students in **rural E-Rate** districts and schools are—according to district and school administrators and teachers—more likely (controlling for other factors) to have the use of technology for instruction limited by students' lack of general technology skills and by the limited availability of technical support staff. Students in **urban E-Rate** settings are, controlling for other factors, more likely to face constraints related to the adequacy of teacher and student technology skills, the availability of technical support staff, building electrical systems, and the speed and reliability of their Internet connections.

- District and school size are associated with greater organizational and technical complexity, as well as increased scale and scope of technology systems. Controlling for poverty and other characteristics, students in **larger E-Rate** districts and schools are more likely to face a number of barriers to the expanded use of educational technology, including availability of adequately trained teachers and of training opportunities for them; availability of instructional computers; teacher access to an e-mail account at school; speed and reliability of the Internet connections; access to technical support; and adequacy of building space and electrical systems. Moreover, controlling for other factors, students in larger E-Rate schools are less likely to have teachers who use educational technology and who use computers for "complex" purposes in their classrooms.

- Finally, controlling for other characteristics, students in **elementary E-Rate schools** are less likely than students in middle and secondary E-Rate schools to have their use of the Internet and other digital technology constrained by the availability of technical support or the technology skills of their teacher.

Reflections on These Results

This study, conducted during the start-up years of the E-Rate, provides some evidence about the program's role in the growing penetration of technology into the nation's public schools. It is far from the last word, and many questions are left unanswered, but these data may inform some future policy decisions.

Can the Efficiency of the E-Rate Application Process Be Improved?

Because the E-Rate is a new and complex program, it is not surprising that district and school administrators have expressed some concerns about the application and approval process. These concerns include difficulty completing the application forms, delays in receiving approved discounts or reimbursements, and problems working with technology vendors. Evidence from an earlier ISET study (Puma, Chaplin, and Pape 2000) also points to lower than expected application rates among the poorest districts, suggesting that these districts may have a lower capacity to deal with the application process and may face financial constraints that limit their ability to pay for the undiscounted cost of technology equipment and services. A more streamlined process may, therefore, be worth considering, especially for institutions that have previously received E-Rate discounts and could be handled through an expedited funding procedure.

Is Greater Flexibility Needed?

Two findings from this study suggest a need to reconsider how E-Rate discounts can be used and, more broadly, how different sources of funding for educational technology could be combined to meet the technology needs of states, districts, and schools.

First, during the E-Rate program's early years, over half of all discounts were used for high-cost "internal connections" related to networking and building wiring, especially the costly retrofitting of older buildings to meet the needs of modern computer technology. At some point, one would expect the need for these costly items to decrease, thereby shifting the distribution of discounts to the less costly acquisition of telephone and Internet services. Such changes may provide an opportunity to reevaluate the allowable uses of E-Rate discounts.

Findings from this and other studies indicate a significant need for technology-related resources not currently supported by the E-Rate. These resources include professional development, access to technical support (particularly that related to helping teachers better integrate the Internet and other digital technology into daily classroom life), and access to a sufficient number of advanced computers and other hardware and software. Consideration should be given to increasing the flexibility with which E-Rate discounts can be used, to better enable schools to meet the intended goal of creating technological parity.

Increased Coordination of Resources

Consideration should also be given to how the E-Rate fits into the broader picture of public and private investments in educational technology, to create a more integrated system of resources. The new Enhancing Education Through Technology (EdTech) program, included in the No Child Left Behind Act of 2001 (the reauthorization of the Elementary and Secondary Education Act of 1965), provides assistance to states for the implementation of comprehensive educational technology systems (this program replaces the TLCF). In particular, the new legislation encourages states to use other federal educational funds in flexible ways to meet their technology goals and to pursue public-private partnerships.

As evidence from this study indicates, states can and do play an important leadership role in educational technology, and this new program is an opportunity to enhance that role by helping districts and schools better coordinate federal (including E-Rate), state and local, and private resources to more effectively use technology to increase the academic achievement of all students.

Unanswered Questions

This study is only a preliminary look at the early implementation of the E-Rate and was not intended to examine the impact of the E-Rate—or digital technology in general—on instruction and learning. More information is needed about the link between E-Rate funding and the closing of the digital divide, especially about differences in the quality of the equipment and services (e.g., access to broadband Internet) that are available to poor and rural communities. In addition, more needs to be known about how E-Rate-supported technology is actually being used in schools and classrooms, and the extent to which the technology is able to transform instruction and learning, as many proponents have predicted. Finally, more information is needed about the demands that this new technology is placing on instructional and other district and school staff, and the extent to which a lack of capacity is constraining the effective use of the acquired technology.

Chapter I: Introduction

Alexis de Tocqueville, writing in the early 19th century, observed that "…the instruction of the people powerfully contributes to the support of the democratic republic."[1] The importance of education in a free society—and, more broadly, open access to information—is undiminished today. Yet, segments of American society—particularly the poor, minorities, and geographically isolated—have limited access to the information revolution brought about by the rapid growth in the use of computers and the Internet.

> **The E-Rate Program**
>
> *Since 1998, the E-Rate has provided nearly $8 billion to help schools and libraries acquire modern telecommunications and advanced digital technologies.*

This report focuses on one federal effort, called the "E-Rate," that seeks to bridge this digital divide by helping public and private schools and libraries (i.e., public technology access points) acquire modern telecommunications and advanced digital technologies. This chapter examines the nature of the digital divide, especially as it relates to children, and the role of schools in reducing inequitable access to digital technology. The chapter then describes the objectives and operations of the E-Rate program, which is the focus of the report.

This report is part of the Integrated Studies of Educational Technology (ISET) commissioned by the U.S. Department of Education to foster knowledge about the use of educational technology and the role of federal programs in supporting educational technology initiatives. The ISET studies examine technology-related issues[2] using a shared set of state-, district-, school-, and teacher-level survey data collected from nested, nationally representative samples of districts, schools, and classroom teachers. This report relies on the merged datasets produced by the three studies, along with program administrative data, as the basis for the analyses that are discussed.

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[1] English translation, de Tocqueville, Alexis, *Democracy in America, Vol. 1* (New York: Knopf, 1945).

[2] The studies focus on the Technology Literacy Challenge Fund (TLCF), the E-Rate program, and technology-related professional development and teachers' use of technology in the classroom.

This examination of the E-Rate is timely, given that the Enhancing Education Through Technology Program (EdTech), established with the reauthorization of the Elementary and Secondary Education Act (ESEA) in January 2002, seeks in part "to assist every student in crossing the digital divide." Allowable uses of funds under EdTech[3] focus on promoting innovative uses of technology to increase student achievement; increasing access to technology, especially for high-need schools; and improving and expanding teacher professional development in technology.

The Digital Divide

Claims abound regarding the importance of the new digital technology—especially the Internet—in today's society, and there are dire predictions for the fate of those slow to enter the "information age." The Internet has an estimated 100 million users worldwide, with projections to a billion in five years (Margherio et al. 1998). In the United States, virtually everyone under the age of 60 (92 percent) has used a computer, and 75 percent have used the Internet (NPR Online 2000). Although unlikely to have heard of the Internet before the early 1990s, most Americans now depend on it for a variety of activities, including communication, shopping, and research. By the end of 2000, half of all households had a home computer, representing a 42 percent increase in two years and a fivefold increase from 1984 (U.S. Department of Commerce 2001). Moreover, 4 in 10 households had Internet access in 2000, up from 26 percent in 1998 and only 18 percent in 1997 (U.S. Department of Commerce 2001).

> **The Digital Divide**
>
> *Significant differences exist in access to computers and the Internet by income, race, and ethnicity.*

Despite this rapid penetration of the computer and the Internet into the fabric of American society, there are significant differences in technology access by income, race, and ethnicity—a gap that many have called a **digital divide.** For example, nearly 9 out of 10 households with incomes over $75,000 have a home computer, and 8 out of 10 can use it to access the Internet, compared with 28 percent and 19 percent, respectively, for households

[3] The program will award grants to states based on the formula for Title I, Part A, ESEA. States, in turn, are to distribute half of their grant funds to districts according to the formula for Title I, Part A and half competitively to districts.

with incomes below $25,000 (U.S. Department of Commerce 2001). Even controlling for income, African Americans are less likely than whites to use the Internet. These economic, racial, and ethnic differences have widened since 1994. In particular, the technology gaps between whites and African Americans, between households in the highest and lowest income groups, and between households in the highest and lowest education-level groups increased between 1994 and 1999 (U.S. Department of Commerce 1999).

These recent data also show that schools, libraries, and community centers serve as important technology access points, especially for the disadvantaged. Individuals without a home computer are 1.5 times more likely to obtain Internet access through libraries or community centers than those with home computers (U.S. Department of Commerce 1999), and the unemployed, as well as African Americans and Asian Americans, are more likely than other groups to use public libraries to access the Internet (U.S. Department of Commerce 2000).

Children and the Digital Divide

Households with children are more likely to have home access to computers and the Internet than households without children. In 2000, nearly two-thirds (65 percent) of all children age 3 to 17 lived in a household with a computer (an increase of 10 percentage points in two years), and nearly one in three children (30 percent) used the Internet at home, increasing from 19 percent in 1998 (U.S. Department of Commerce 2001). But, as with households in general, poor and minority children are less likely to have a home computer. Among children age 3 to 17, 77 percent of white non-Hispanic children had a home computer and 38 percent had home Internet access in 2000, compared with 43 percent and 15 percent for African-American children and 37 and 13 percent for Hispanic children, respectively (U.S. Department of Commerce 2001).

Schools and the Digital Divide

Poor and minority children are less likely to have access to computers and the Internet at home.

Schools help reduce this inequity in access to technology.

One of the most important ways to narrow this technology gap is to improve children's access to computers and the Internet at school. For example, two out of three school-age children (age 6 to 17) had access to a home computer in 2000, but four out of five used a computer at school, and more than half (57 percent) had access to a computer both at home and at school. More important, schools have helped close the income, racial, and ethnic gaps in technology access. There is about a 60 percentage point gap in the rate of home computer access between school-age children from households with incomes over $75,000 (94 percent) and those from households with incomes under $25,000 (35 percent). However, this difference shrinks to 15 percentage points for access to a computer at school (87 percent vs. 72 percent). Similar reductions are found by race and ethnicity: The gap in home access to a computer between white and African-American children is 45 percentage points (79 percent vs. 34 percent) and between white and Hispanic children is 41 percentage points (79 percent vs. 38 percent), but these gaps decline to 12 and 14 percentage points, respectively, in terms of school access to a computer.

Access to Computers and the Internet in School

Nearly 90 percent of Americans support the introduction of educational technology into American schools and libraries, and most (83 percent) see the Internet as a way to improve educational opportunities for all Americans, especially for disadvantaged children (EdLiNC 1999, 2000). According to many proponents, increasing the educational uses of computers and the Internet may provide an opportunity to transform teaching, predicting a move toward more student-centered instruction based on content-rich real-world applications—what some have called the transformation of the classroom teacher from "the sage on the stage" to "the guide on the side." For example, Schacter (1999) found that teachers in high-end "technology-rich classrooms" moved from the traditional lecture mode to engage students in cooperative group-learning activities for instruction.

School Internet Access

Nearly all public schools and more than three-quarters of classrooms had Internet access in 2000. But wealthy schools are more likely to have classroom access.

This gap is closing, however, coinciding with the growth in the E-Rate, which had, by the end of 2001, committed nearly $8 billion for digital technology.

Whether modern digital technology can meet the sometimes lofty goals of its proponents or not, it has clearly made substantial inroads into the nation's schools. For example, between 1994 and 2000, the proportion of public schools connected to the Internet increased from 35 to 98 percent, eliminating prior differences by school poverty, grade level, and urban location (NCES 2001).[4] At the classroom level, where technology can be better integrated into daily instruction, 77 percent of all public school classrooms had Internet access in 2000, representing a dramatic increase from only 3 percent in 1994 (NCES 2001).

The problem is that the wealthiest schools remain more likely than the poorest schools to have classroom access (82 percent for schools with under 35 percent poor children vs. 60 percent for schools with 75 percent or more poor children), although the gap is closing. Classroom access to the Internet in the poorest schools increased from 38 percent of classrooms in 1998 to 60 percent in 2000. In addition, the quality of school Internet connections has also greatly improved, with 77 percent of the poorest schools now connected through dedicated lines instead of slower dial-up service (NCES 2001). At least in part, this closing of the gap between high- and low-poverty schools is likely due to the E-Rate (described below), which has committed nearly $8 billion to help schools and libraries gain access to affordable digital technology.

But the mere availability of computers and the Internet does not mean that teachers are making use of what the new technology has to offer. Studies indicate that it is not simply access to technology that is important for students, but rather how teachers use technology as a tool to enhance learning (Thompson, Simonson, and Hargrave 1996). As Becker (2000) notes,

"…under the right conditions—where teachers are personally comfortable and at least moderately skilled in using computers themselves, where the school's daily class schedule permits allocating time for students to use computers as part of class assignments, where enough equipment is available and convenient to permit computer activities to flow seamlessly alongside other learning tasks, and where teachers' personal philosophies support student-centered, constructivist pedagogy that incorporates collaborative projects defined partly by student interests – computers are clearly becoming a valuable and well-functioning instructional tool."

[4] Private schools have seen similar but slower changes, with Internet access increasing from 25 to 67 percent between 1995 and 1998. Private schools also lag in instructional room access, at 25 percent in 1998, but this level of access still represents a significant increase from 5 percent of all private school classrooms in 1995 (NCES 2000a).

Although most teachers occasionally assign computer work to students, relatively few use computers for a significant part of their daily instruction (Becker 1990, 2000; Cuban 1993, 2000; Technology Counts 1998). For example, a recent report from the U.S. Department of Education (2000), estimated that most teachers (88 percent) with access to computers have their students use them, but only about a quarter do this "often." Similarly, Lemke et al. (1998) found that, on average, classroom activities incorporating technology involve only a small portion of instructional time, and Dexter, Ronnkvist, and Anderson (2000) reported that the percentage of teachers who frequently use technology with their students (i.e., more than once a week) was approximately 25 to 30 percent. Recent data from SRI International (2002) show an increase in the incidence of "frequent" use of computers for instruction (once a week or more) to about 55 percent, with higher rates among elementary school teachers compared with secondary teachers (69 percent vs. 43 percent). On average, children's total use of computers (including both inside and outside school) averages about 31 minutes a day, and only a fraction of this time is devoted to using the Internet (Roberts et al. 1999).

The most common classroom uses of educational technology involve "low-level" activities, including word processing, improving computer skills, doing research on the Internet, using it as a free-time activity or reward, and doing practice drills (SRI 2002). Even among the "frequent" users of educational technology, higher-level activities are an uncommon part of their instruction. For example, only about 10 percent of teachers rated as frequent users reportedly have their students do research using the Internet (SRI 2002). Part of the reason for the observed level of technology use is that only about 42 percent of teachers report feeling "moderately well prepared" or "very well prepared" to use computers and the Internet in their teaching (SRI 2002). Moreover, 40 percent of teachers reported that "inadequate training opportunities" posed a moderate to great barrier to their technology use during instruction (SRI 2002).

The E-Rate Program[5]

The E-Rate has its roots in the 1930s when, concerned about unequal access to telephones, Congress initiated a program of publicly supported "universal service" to ensure that poor and geographically isolated communities would not be excluded from the first American "information revolution" (a period of enormous growth in radio and telephone communications). The 1934 Communications Act sought to "*make available, so far as possible, to all the people of the United States, a rapid, efficient Nation-wide, and world-wide wire and radio communication service with adequate facilities at reasonable charges.*"

Similar concerns today about a growing digital divide led Congress to pass the Telecommunications Act of 1996 (Public Law 104-104), which, among other things, extended the idea of universal service to include 21st-century telecommunications technology (e.g., digital communications and access to the Internet), targeting financial assistance to public and private nonprofit educational institutions—important access points for disadvantaged individuals. The Federal Communications Commission (FCC) subsequently adopted a Universal Service Order on May 7, 1997, that included the Schools and Libraries Support Mechanism, commonly called the E-Rate. The not-for-profit Universal Service Administrative Company (USAC) is responsible for administering the overall Universal Service Fund under the direction of the FCC, and the Schools and Libraries Division (SLD) of USAC administers the E-Rate component of the fund.

The E-Rate seeks to increase equitable access to digital technology through the provision of financial assistance to public and private nonprofit educational institutions, subject to an overall $2.25 billion annual program cap. Under the program, approved schools and libraries receive discounts on qualifying telecommunication services ranging from 20 to 90 percent; that is, they pay less than market cost to obtain eligible technology equipment and services.[6] Approved discounts are based on the percentage of students eligible for participation in the National School Lunch Program[7] and whether the school or library is located in a rural area.

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[5] See appendix A for a more detailed description of the E-Rate.

[6] In some cases, service providers include the discount on the bill sent to the approved school or library. In other cases, the institutions must pay the full cost of the acquired equipment or service and file for reimbursement from SLD.

[7] For libraries, the discount is based on the poverty level of the school district in which they are located.

Communities with higher concentrations of poor children and those in rural areas receive higher discounts. In a given funding year, eligible institutions may submit multiple E-Rate applications, either individually or as part of a consortium that may include other entities, including those not directly eligible for E-Rate discounts.[8]

The E-Rate supports the acquisition of digital technology infrastructure, including telephone services (basic, long-distance, and wireless), Internet and web site services, and the acquisition and installation of network equipment and services such as wiring in school and library buildings. Other components of an educational technology system—including computer hardware and software, staff training, and electrical upgrades—are not covered under the E-Rate. Through January 2000, the largest share of E-Rate discounts (58 percent) supported the acquisition of equipment and services for internal building connections, with the poorest districts receiving higher average discounts for this purpose (Puma, Chaplin, and Pape 2000). This may reflect a greater need in these schools for the basic infrastructure required to support the effective use of telecommunications services. The remaining E-Rate discounts through January 2000 were used for telecommunications services (34 percent) and Internet access (8 percent). Each year, the SLD prioritizes applications, first approving requests for telecommunications and Internet access equipment and services, and then those for internal connections (i.e., connections to classrooms and workstations), starting with the applications that qualify for the highest discount rate (i.e., higher discounts are given higher priority).

The E-Rate is a relatively new and very large program that, not surprisingly, has undergone some growing pains, some of which are discussed in appendix A and also documented in an early report by the General Accounting Office (GAO 1998). Although program management was not a focus of this study, qualitative information was obtained

[8] Participating as part of a consortium may lower the prices paid for eligible equipment and services through increased economies of scale; may result in lower operating costs through the sharing of network infrastructure, facilities, and technical knowledge; and may also increase efficiency.

from some administrators of schools receiving E-Rate discounts[9] that provides a perspective on issues confronting educators who used the program during its first two program years.[10]

The application forms reportedly require about 50 hours to complete, and most of the respondents did not report a problem with the application. The following were the most commonly reported problems:

(1) Finding the information needed to document the level of existing technology resources.

(2) Dealing with changes to the requested equipment or services during the application period. One principal suggested that *"substitution of 'functionally equivalent' eligible items should be allowed* ***without*** *the need of filing amended applications or additional documents."*

(3) Working within the constraints of state or district policies or procedures.

(4) Delays in receiving notification of approved discounts or reimbursements from the SLD. As some principals indicated: *"In Year 1 we never received any notice that we were accepted or rejected. I filed an appeal with no response." "We are still waiting to hear from our Year 2 second window application* [received in June, 2001]." *"Funding is currently more than a year behind."*

(5) Problems understanding program information provided by the SLD. As some principals indicated: *"The information available should be 'English friendly' to allow for more people to be involved." "The application process is … prohibitively burdensome." "too much red tape!" "With small staff, simply did not have time to apply." "The application process is complex and convoluted…and very time-consuming." "It's a very cumbersome process."* The most commonly reported sources of E-Rate information and/or technical assistance were the SLD, state- or district-sponsored conferences or briefings, state- or district-provided web-based materials or telephone/e-mail help lines, and commercial vendors.

Some of the anecdotes reported by this nonrepresentative sample of school principals also indicate a possible misunderstanding about eligibility for E-Rate discounts. Although all schools are eligible for at least a 20 percent discount, some individuals seem to believe otherwise. For example, one principal said, *"We have never qualified—too affluent, only 47 percent free and reduced-price lunches."* Another school director of information systems said this: *"It is unfair to the other schools and students in my district whose free and reduced lunch count is less than 80*

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[9] This information is derived from the E-Rate survey module that experienced relatively poor respon se rates and thus may not be representative of all E-Rate program participants. These data should not, therefore, be used to draw broad conclusions about the program. The data are offered only as suggestive information.

[10] Program Year 1 ran from January 1998 through June 1999; Year 2 ran from July 1999 through June 2000.

percent and probably will not qualify for funding….We appreciate the help, but let's help all the students." And finally, a third principal indicated that his school did not receive E-Rate discounts because *"We were told that only schools with 90 percent or more free or reduced lunch were eligible."*

Somewhat similar findings were reported by Carvin (2000) based on case studies of the E-Rate in Chicago, Cleveland, Detroit, and Milwaukee. According to the author, delays in obtaining reimbursements from vendors for approved E-Rate discounts created a financial hardship for these districts. Staff also reported difficulty obtaining infrastructure not supported by E-Rate (e.g., electrical upgrades, computer hardware) and said that this limited their ability to take full advantage of discounted equipment and services. Vendors also reportedly faced difficulty obtaining needed supplies and labor to meet E-Rate-related demands for equipment and services. For example, two principals in the ISET study said: *"Getting discounted telephone rates has been good, but our local telephone provider has been very difficult to work with." "For basic telephone service, there is no incentive for the telephone company to assist or even apply for a discount for us."*

A subsequent examination of the same four districts (Benton Foundation 2001) found that although the E-Rate helped them acquire sophisticated digital telecommunications systems rivaling those in wealthy suburban districts, they were far from "transforming those investments into gains in teaching and learning (p.18)." Factors that affected the ability of these districts to use the acquired technology included "the cost of upgrading electrical systems, the need to train massive numbers of teachers, the presence of competing reforms and contradictory district mandates, the presence of high-stakes assessments (p.18)."

These types of concerns reflect the maturing nature of the E-Rate program, and the SLD has tried to be responsive to the needs of its clientele. In fact, the FCC released a Notice of Proposed Rule Making, with several suggested administrative changes, on January 25, 2002, for public comment.

This Report

This report adds to our knowledge about the E-Rate during its first two program years (January 1998 through June 2000) using a variety of information—program administrative data, a survey of technology coordinators in all 50 states and the District of Columbia, and nationally representative surveys of public school districts, schools, and teachers. Chapter II describes the study methods, Chapter III focuses on indicators of the program's efforts to equalize access to the Internet and other digital technology, Chapter IV examines issues related to the use of E-Rate-supported digital technology in schools, and Chapter V presents overall conclusions and recommendations. Several appendices provide additional details, including statistical results.

Chapter II: Study Overview

This report is part of the Integrated Studies of Educational Technology (ISET), designed to address a range of questions about the use of computers and the Internet in America's public schools. The U.S. Department of Education's Planning and Evaluation Service sponsored ISET, in collaboration with the Office of Elementary and Secondary Education, the Office of Educational Technology, and the Schools and Libraries Division (SLD), which administers the E-Rate. In addition to this study of the E-Rate, ISET includes a study of the implementation of the Technology Literacy Challenge Fund (TLCF) and a study of technology-related professional development and teachers' use of educational technology. A more complete description of ISET—including the multilevel sample design and data collection methods—is provided in appendix B.

The Formative Evaluation of the E-Rate

As discussed in Chapter I, the E-Rate is intended to reduce the digital divide by equalizing access to telecommunications and advanced digital technologies at public educational institutions, particularly schools and libraries. As stated in the National Information Infrastructure Advisory Council report (NIIAC 1995) that provided the impetus for the E-Rate, there was a compelling need *"to deploy Information Superhighway access and service capabilities to all community-based institutions that serve the public, such as schools and libraries."*

The E-Rate Evaluation

Research questions focus on the extent to which the E-Rate equalizes access to digital technology, and the ability of schools and teachers to use the supported technology for instruction.

Two sources of data are used: (1) national surveys of states, districts, schools, and teachers, and (2) E-Rate administrative records through January, 2000.

This study represents an early look at the E-Rate program in the nation's public schools during its first two program years (January 1998 through June 2000), addressing two broad policy questions:

(1) To what extent is the E-Rate helping to equalize access to the types of digital technology eligible for program discounts?

(2) Are schools and teachers able to use the technology that E-Rate supports? How is it being used in the classroom?

To answer these questions two data sources were used:

(1) ***ISET surveys conducted during school year 2000–2001***, including a survey of technology coordinator in all 50 states and the District of Columbia, a survey of technology coordinators in a national sample of 1,061 districts,[11] a survey of principals in a sample of 1,106 schools within the sample of districts, and a survey of 1,750 teachers from a subsample of 473 schools. The state, district, and school surveys were administered using a web-based system with paper completion as an option; the teacher survey used a paper questionnaire. Full-scale data collection—covering the 1999–2000 school year—ran from November 2000 through May 2001.

(2) ***E-Rate administrative data*** covering all E-Rate applications and funded commitments through January 2000.[12]

The **Survey of State Technology Coordinators** collected information on the following: state efforts to support educational technology; how technology is being integrated into teacher education, student assessments, and curriculum standards; sources, amounts, and uses of educational technology funds; and efforts to assess the impact of educational technology programs. The **Survey of District Technology Coordinators** focused on the following topics: educational technology planning; educational technology funding, particularly the TLCF program; technology-related teacher professional development; technical support for educational technology; equipment availability and use, including Internet access; the integration of technology into instruction; and district efforts to assess the effects of educational technology.

The **Survey of School Principals** collected data on the following: educational technology planning; financial and other resources available for educational technology;

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[11] A separate survey of financial officers in a subset of districts was also conducted, but very low response rates precluded the use of these data.

[12] For more details on the administrative data—particularly linking to information on districts and schools—see Puma, Chaplin, and Pape 2000. Because of resource and time limitations, additional administrative data beyond January 2000 were not obtained for this report.

experiences with the E-Rate (a separate module);[13] equipment availability and use, including Internet access; allocation of educational technology to teachers and classrooms; barriers to effective technology use; technical assistance; how technology is used for classroom instruction, including controlling inappropriate use; and the perceived benefits of educational technology. Finally, the **Survey of Classroom Teachers** collected information on their assessment of their own and their students' technology skills; access to educational technology in and outside of school, including the Internet; access to technical support; the receipt of technology-related professional development; classroom use of technology; and barriers to the effective use of technology for instruction.

Despite several efforts to encourage responses to the various surveys (see appendix B), initial response rates for the district and school surveys were below expectations and at a level that would not support reliable analysis. Consequently, a final effort was made to increase respondent cooperation. This effort involved drastic reductions of the district and school questionnaires to a small set of "critical items"—from 79 to 23 items for the district survey and from 70 to 14 items for the school survey. (The teacher survey was not altered.) These reductions, combined with changes in the use of incentives and the timing of the final survey wave (near or after the end of the school year), resulted in substantial increases in survey response rates, to 82 percent for districts and 78 percent for schools.[14] The cost of obtaining these high response rates, however, is that some of the original research questions cannot be addressed in this report, and other research questions are informed by only a single survey item. In particular, the loss of detailed information on the availability of digital technology equipment and services, as well as on technology-related expenditures—the primary areas of relevance to the E-Rate—seriously limited the dimensions along which anticipated program-related benefits could be assessed.

[13] This separate E-Rate module (part of the survey of school principals) had an overall low response rate, primarily because school-level respondents were generally unfamiliar with the details of their E-Rate application and funding. These data—obtained from 208 schools out of 856 schools that responded to the school survey—are, therefore, used only as qualitative information in chapter I. A similar E-Rate survey module for districts was originally planned but was dropped because of unexpected problems.

[14] An additional 18 school responses were received too late to be used in this analysis. If counted, these responses would raise the response rate to about 80 percent for schools.

Analysis Methods

The results discussed in the remainder of this report are primarily derived using weighted least-squares regression[15] to account for the substantial underlying differences between E-Rate and non-E-Rate districts and schools, as well as among participating E-Rate institutions (see appendix D). All the regressions included the following key covariates:

- **District-level analyses:** (1*)* **poverty** based on the proportion of children ages 5 through 17 who live in poverty;[16] (2) **enrollment size** equal to the number of enrolled students divided by 1,000; (3) **location**—*urban* defined as either central or mid-sized city, *fringe* defined as urban fringe of large and mid-size cities plus large towns, *rural* including small towns and rural areas; and (4) **TLCF participation** determined using program administrative data and defined as districts that received funds at any time between the 1997–98 and 1999–00 school years.

- **School- and teacher-level analyses:** (1) **poverty** based on the proportion of students receiving free lunch; (2) **enrollment size** as defined above; (3) **location** as defined above; and (4) **school type**—elementary defined as schools whose lowest grade ranges from prekindergarten to third grade, and whose highest grade is up to eighth grade versus all others (i.e., middle schools including grades ranging from 4 through 9 and secondary schools including grades ranging from 7 through 12).

E-Rate participation was determined using SLD administrative data as of January 2000. For districts, because more data were available from the E-Rate applications, a "continuous" measure of E-Rate participation was created, defined as the proportion of total district enrollment in schools targeted by the district for E-Rate funding. For schools (and teachers), only a discrete measure could be used, indicating that a particular school was targeted for discounts on an E-Rate application (the school applied on its own or was included on a district or consortia application). Only statistically significant differences (at the 0.05 level or better) are discussed in the text, controlling for the covariates listed above; however, all regression results are shown in appendix C.

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[15] District and school data were weighted to the total of all public school students in the United States. The regression analyses also incorporated standard errors corrected for the complex multilevel ISET sample design, using a jackknife procedure in WesVar (see *WesVar 4.0: User's Guide,* Rockville, Md.: Westat Inc., no date).

[16] The poverty variable was prepared by the Census Bureau and NCES using the same projections that were used for the allocation of Title I funds.

Chapter III: Equalizing Access to Digital Technologies

Introduction

The E-Rate is intended to provide financial assistance to schools and libraries for the purpose of equalizing access among poor and geographically isolated communities to telecommunications and advanced digital technologies. This chapter provides some information on two indicators of the success of this overall program goal:

- the extent to which E-Rate discounts have gone to the intended target group of poor and rural communities; and
- whether access to the Internet and other digital technologies is increasing among E-Rate districts and schools, and where any inequities seem to persist.

This chapter also looks at how the E-Rate fits in with other resources intended to support the availability and use of educational technology, and what states are doing to help increase access to the types of technology supported by the E-Rate. Before discussing these results, however, it is important to understand certain limitations that affected the preparation of this chapter.

Attempts to Assess the Effect of the E-Rate

What evidence would indicate a positive effect of E-Rate discounts on equity of access to digital technology? Logically, one would want to see (1) significant technological differences between schools in poor and rural communities and those in more advantaged communities prior to the E-Rate, (2) the targeting of significant E-Rate discounts to these neediest communities, and (3) a reduction of the technological differences as a consequence of the receipt of the E-Rate discounts. In other words, a possible test of the program's effect is a comparison of pre- versus post-E-Rate differences (or "gains") in Internet access in E-Rate districts and schools and non-E-Rate districts and schools. A greater gain in Internet access by E-Rate recipients would suggest a positive impact of the discounts.

Such a comparison could not be conducted for this study, however, because of a lack of reliable information on pre-E-Rate access to digital technology. Instead, we attempted to compare post-E-Rate technology-related **outcomes** (as opposed to gains) for eligible institutions that did and did not receive E-Rate funds. This weaker comparison also proved unsatisfying because (as discussed later in this chapter) the E-Rate program has been so successful at reaching the majority of the nation's public schools. As shown in appendix E, there are relatively few non-E-Rate districts and schools,[17] and they are significantly different from E-Rate participants on a number of important background characteristics (e.g., concentration of poor students). Regression analyses (presented in appendix C) found only three marginally statistically significant[18] educational technology differences between E-Rate participants and nonparticipants, and these were unrelated to the primary focus of the E-Rate.[19]

A final approach to this analysis used the E-Rate discount formula as a sort of "natural experiment" to deal with the existence of both "observable" (e.g., poverty and rural location) and "unobservable" (e.g., motivation to increase the use of technology) differences between E-Rate and non-E-Rate districts and schools. Ignoring unmeasured differences can lead to the erroneous attribution of effects to the receipt of E-Rate discounts. Specifically, the E-Rate discount level was included in regression models assuming that it affects outcomes via the E-Rate program but would have no other direct effects on the outcomes of interest, controlling for poverty rates and rural location. This approach was expected to work because small changes in the percentage of enrolled students eligible for free or reduced-price meals (the E-Rate measure of poverty) can cause very large changes in the discount rate. These changes, in turn, may have larger effects on access to and use of the Internet than would be

[17] Non-E-Rate districts account for only an estimated 4 percent of all public school students, and non-E-Rate schools account for only an estimated 10 percent of all public school students.

[18] All results discussed in this report are statistically significant at the 0.05 level or below. The use of the term "marginally significant" here refers to statistical significance at the 0.10 level but not at the 0.05 level.

[19] Students in E-Rate districts and schools are marginally more likely than students in non-E-Rate districts and schools to have their district technology coordinator or principal report that inadequate technology knowledge or support among school administrators (11 and 10 percentage points for districts and schools, respectively) is a barrier to the effective use of educational technology, after controlling for poverty, size, urban location, and receipt of TLCF grants. Students in E-Rate schools are more likely than those in non-E-Rate schools to have teachers who feel well prepared to use computers and the Internet (an 11 percentage point difference) and more likely to have teachers with "basic" skills with Internet browsers (a 7 percentage point difference), controlling for other school characteristics. These few significant results are due, in large part, to the fact that the E-Rate/non-E-Rate differences are associated with relatively large standard errors resulting from the relatively small number of non-E-Rate participants in the survey sample.

expected given the concurrent small changes in school poverty.[20] These analyses, presented in appendix F, failed to support the conclusion that the discounts may have had an impact on technology, at least by the end of the first program year (1998–99).

As a result, the indicators described in this chapter, although important, provide only a preliminary look at the role of the E-Rate in equalizing access to the Internet and other supported digital technologies.

Has the E-Rate Targeted the Intended Needy Communities?

An analysis of all E-Rate applications and discount approvals through January 2000 (Puma, Chaplin, and Pape 2000) indicates that the vast majority of approved E-Rate discounts (84 percent) went to the nation's public schools. In part, this is due to differences in the program's penetration—more than three-fourths of all public districts and schools applied for E-Rate discounts, compared with about half of all public libraries and 15 percent of all private schools (Puma, Chaplin, and Pape 2000).

More important, the E-Rate has successfully targeted the poorest communities—as of January 2000, the per student discounts provided to the most disadvantaged school districts were almost 10 times higher than those given to the least disadvantaged districts (Puma, Chaplin, and Pape 2000).[21] Urban schools and libraries, which are generally larger and have greater concentrations of poor children, received comparatively larger average discounts. Isolated rural schools also benefited, with higher E-Rate discounts going to rural schools at which up to half of the students receive subsidized school meals. Finally, schools located in officially designated federal Empowerment Zones and those associated with the Bureau of

[20] For example, as shown in appendix A, schools at which fewer than 1 percent of students are eligible for free or reduced-price lunch receive a 20 percent discount on eligible services and equipment, while schools with 1 percent free lunch receive discounts of either 40 or 50 percent, depending on urban or rural location. Consequently, the latter group of schools can obtain twice the E-Rate funding for educational technology as the former group, even if they apply for the same total amount of services. Similarly, at the upper end of the discount formula, moving from 74 percent to 75 percent free lunch moves the discount rate from 80 to 90 percent. This difference can cut net expenditures of these schools in half (i.e., from 20 to 10 percent of the cost). Such large discount rate differences suggest the possibility of relatively large differences in outcomes associated with small poverty differences (i.e., at the subsidy "break points"), much larger than would be associated with similar small changes in percentage free lunch at other points in the distribution.

[21] Application rates for the most impoverished public school districts were somewhat lower than those for other poor districts in the first year of the program, possibly reflecting the lower institutional capacity of those school districts, but the differences declined in the program's second year (Puma, Chaplin, and Pape 2000).

Indian Affairs (BIA) have taken greater advantage of the E-Rate than other schools, even after controlling for poverty and urban location.[22]

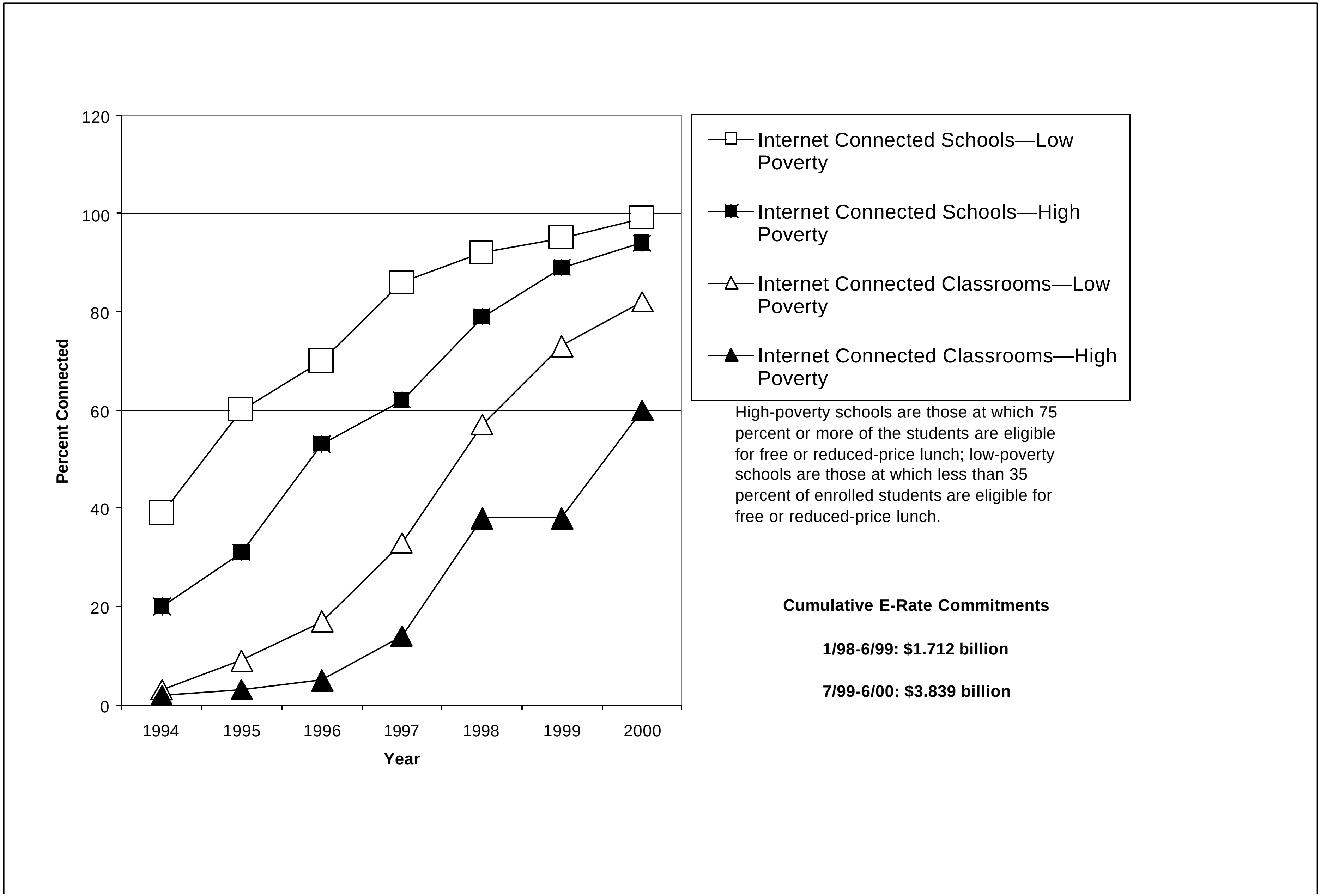
> **E-Rate Targets Needy Communities**
>
> *Schools have been the greatest beneficiaries of the E-Rate, receiving 84 percent of all discounts.*
>
> *The E-Rate has been successful at targeting the poorest communities, and both urban and rural schools have benefited from the program.*
>
> *The poorest schools appear to be closing the "connectivity" gap in line with the commitment of nearly $8 billion in E-Rate discounts to schools and libraries.*

Other evidence shows that schools have actively sought to expand the availability of digital technology: Virtually every public school is now connected to the Internet; connections exist in nearly 8 out of 10 public school classrooms; and faster dedicated lines are quickly replacing slower dial-up service access to the Internet (NCES 2001). And, as shown in exhibit 1, although wealthy schools remain more likely to have Internet access at the classroom level, recent increases in classroom access in the poorest schools (since stagnating in 1998) have coincided with the commitment of nearly $8 billion in E-Rate discounts to schools and libraries through November 2001.

At a minimum, then, it appears that the E-Rate has provided a partial "financial bridge" across the digital divide separating the poor, minorities, and geographically isolated from equitable access to computers and the Internet. This result is particularly important for low-income children for whom, as discussed in chapter I, school may be the primary path for reducing inequitable access to modern digital technology.

[22] For more detail on Empowerment Zones and BIA schools, see appendix D.

Exhibit 1: Changes in School and Classroom Internet Access, 1994–2000 (NCES 2001)



Access to the Internet and Other Digital Technology

For those institutions that have received E-Rate discounts, is there any evidence that this assistance has increased access to the Internet or other digital technology? Two perspectives on this question are discussed in this section: (1) information from approved E-Rate applications; and (2) information obtained from the Integrated Studies of Educational Technology (ISET) survey of teachers.

E-Rate Administrative Data

As part of the application process, schools and libraries are required to provide information on both their existing level of services and that planned after the receipt of E-Rate discounts. This includes data on the number of phones per student (not per teacher), the number of Internet-connected computers per student, the number of teleconferencing links per student, the fraction of buildings connected to the Internet, the fraction of classrooms connected to the Internet, the total number of Internet connections per student, and the highest speed of these Internet connections (phone, direct, and overall).

These data were examined for public school districts that applied for E-Rate discounts on behalf of the **same set** of schools in both 1998–99 and 1999–00. This restriction was imposed to ensure that results were unaffected by the composition of districts compared across years.[23] The results of this analysis, shown in exhibit 2, indicate that existing services increased in all areas from 1998–99 to 1999–00, except for the maximum speed of phone lines (data not shown in the table[24]). This suggests that E-Rate-funded applicants (or at least those that applied in both years for the same set of schools) have reportedly increased access to the Internet and other digital

Reported Changes in Access

Internet-connected computers and Internet connections per student, phones per student, fraction of buildings and classrooms connected to the Internet, and the speed of Internet connections all increased from 1998 to 1999 as reported by E-Rate applicants.

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[23] According to the SLD, 66 percent of districts reapplied for the E-Rate in 1999–00, and 75 percent reapplied in 2000–01.

[24] The lack of improvement in phone speed makes sense, given that many of these districts may have used their discounts to move away from phone lines to faster methods of connecting to the Internet.

technology. It should be noted, however, that the **planned** (rather than existing) level of services reported on the 1998–99 applications was generally higher than the **existing** level of services reported on the 1999–00 application, which suggests that most of the E-Rate districts were not able to put their planned services into place by the time they submitted their 1999–00 application. This situation may be related, at least in part, to the reported delays in receiving E-Rate discounts discussed in chapter I.

Exhibit 2*: *District Access to the Internet and Other Digital Technology, and Annual Changes from 1998 to 2000

	Level of Existing Service and Changes			Services Planned for 1999–00 Mean (Standard Deviation)
Types of Service	**1998–99 Mean (Standard Deviation)**	**1999–00 Mean (Standard Deviation)**	**Mean Change 1998–99 vs. 1999–00 (Standard Deviation)**	
Phones per student (N=4,800)	0.029 (.03)	0.032 (.03)	0.003 (.02)*	0.034 (.04)
Internet-connected computers per student (N=3,892)	0.113 (.11)	0.161 (.13)	0.048 (.09)*	0.206 (.15)
Conferencing links per 100 students (N=857)	0.017 (.04)	0.023 (.06)	0.007 (.05)*	0.054 (.14)
Fraction of Internet-connected buildings (N=414)	0.395 (.26)	0.485 (.26)	0.090 (.23)*	0.603 (.23)
Fraction of Internet-connected rooms (N=1,041)	0.362 (.30)	0.478 (.30)	0.116 (.27)	0.621 (.28)
Total Internet connections per student (N=3,873)	0.014 (.04)	0.019 (.05)	0.005 (.04)	0.025 (.07)
Maximum Internet connection speed (Mb; N=4,129)	15.03 (30.1)	26.09 (40.5)	11.06 (33.9)*	38.93 (48.2)

*=p<0.05

Source: E-Rate administrative data, January 2000 (applications for same schools in 1998 and 1999)

Teacher-Reported Access to Digital Technology

A second perspective on access to digital technology in E-Rate-supported districts and schools comes from several questions on the ISET teacher surveys. As shown in exhibit 3, about two-thirds of students in public E-Rate schools have teachers who reportedly have access to their school's computer network from home, and over half (57 percent) of these students have teachers who can also access the Internet from home through their school's network. Such home access is important, as it provides greater opportunities for teachers to use the Internet both for professional development and to plan classroom instruction, and also provides the opportunity to use digital technology for purposes such as recordkeeping and communication with students, peers, and parents.

Students in the poorer E-Rate schools are less likely to have teachers who report such home access than students in wealthier E-Rate schools (a difference of 26 percentage points for home network access between the poorest and wealthiest schools), controlling for differences in school size, location, and grade level. Students in rural E-Rate schools are estimated to be 14 percentage points less likely to have teachers who can access the Internet from home through their school's computer network than students in suburban E-Rate schools, controlling for the same school characteristics.

Most students in E-Rate schools (80 percent) also have teachers who reportedly have access to an e-mail account at their school, but there are statistically significant differences by school characteristics. Controlling for other school characteristics, it is estimated that students in **larger** E-Rate schools, **rural** E-Rate schools, and **elementary** grade E-Rate schools are **less likely** than students in smaller, suburban, and secondary E-Rate schools, respectively, to have teachers who have been provided with an e-mail account for their use at school.

***Exhibit 3*: Access to Digital Technology Reported by Teachers in E-Rate Schools**

Type of Access	Percentage of Students in E-Rate Schools (Standard Error)	Regression Estimates, Statistically Significant Differences among E-Rate Schools
Teachers have access to the school's computer network from home	63.2% (2.08)	Poverty: -25.8%***
Teachers have access to the Internet from home through the school's network	56.6% (2.12)	Poverty: -16.3%* Rural school: -14.3%**
Teachers have access to a telephone at school	81.8% (1.60)	Urban school: -8.9%**
Teachers have access to an e-mail account at school	79.7% (2.04)	Size: -0.01%*** Rural school: -15.5%*** Elementary school: -17.7%***

*=p<0.10, **=p<0.05, ***=p<0.01

Source: ISET survey of teachers, school year 1999–2000

The Relationship between E-Rate and Other Funding Sources

The E-Rate, with funding commitments totaling $7.7 billion between 1998 and 2001 (an average of about $1.9 billion per program year), is the largest public investment specifically targeted to increasing the use of technology in the nation's elementary and secondary schools, particularly for those that have high concentrations of poor children or are geographically isolated. The E-Rate is, however, only part of a patchwork of funding sources available to districts and schools to support their investments in educational technology. For example, the Technology Literacy Challenge Fund (TLCF) provided a total of $1.9 billion between 1997 and 2001 (its final year) to states for their use in making competitive grants to local school districts to support their efforts to implement technology plans. In addition, it is estimated that Title I of the Elementary and Secondary Education Act (ESEA), which targets disadvantaged students, has also indirectly supported educational technology, with an estimated $287 million in the 1997–98 school year alone (Chambers et al. 2000), and the Star Schools program provides about $60 million in annual funding to support distance learning opportunities.[25]

In addition to these federal sources, districts and schools have the potential for accessing funding and other types of support for educational technology from their respective state governments, as well as from a variety of private nonprofit and for-profit organizations and local community volunteers. This section examines the relationship between E-Rate and TLCF funding, and between E-Rate and school access to nongovernment technology resources.

E-Rate and TLCF Grants

The E-Rate and TLCF are administered by two different federal agencies, and they target different aspects of educational technology. The E-Rate is narrowly focused on helping schools acquire needed telecommunications equipment and services, while TLCF was more broadly intended to help schools increase their capacity to integrate educational technology into daily teaching and learning.

TLCF and E-Rate

TLCF districts received substantially higher average E-Rate discounts.

Although the survey data do not describe how these two funding sources are being combined to meet educational technology plans, as shown in exhibit 4, about half the students attending public school districts that receive E-Rate discounts also benefited from TLCF funding. Of more interest is that the average E-Rate discount per student is substantially **higher** in TLCF districts: Districts that received a TLCF grant any time between 1997–98 and 1999–00 received an average of $33 per student in E-Rate discounts, compared with only $21 per student in non-TLCF districts. Because E-Rate discounts are larger in high-poverty districts, this is probably an indication that both programs targeted the most disadvantaged communities.

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[25] Other Department of Education programs related to technology include Technology Innovation Challenge Grants, which identify effective uses of educational technology; Preparing Tomorrow's Teachers to Use Technology, which supports reforms in teacher preservice training related to technology; and the Learning Anytime Anywhere Partnerships, which seek to improve the use of distance learning for postsecondary education and training.

Exhibit 4**: **E-Rate Participation and Average Discounts for Public School Districts, by TLCF Participation

E-Rate Participation in 1998–99 or 1999–00	Percentage of Students in Districts (Standard Error) and Average E-Rate Discount	
	Districts with a TLCF Subgrant	Districts Not Receiving a TLCF Subgrant
District receives E-Rate discount	51.2% (0.49)	48.8% (0.49)
Average E-Rate discount per student	$33.05	$21.37

TCLF=Technology Literacy Challenge Fund
Source: E-Rate administrative data through January 2000, and TLCF administrative data for 1997 through 2000

Access to Nongovernment Technology Resources

Nongovernment Resources

Students in the poorest E-Rate schools are less likely than those in the wealthiest E-Rate schools to have access to nongovernment resources for technology.

As shown in exhibit 5, nearly 4 out of 10 students in E-Rate schools receive technology assistance from a source other than the federal or state government or their school district. What is more important for federal policy, however, is that students in **poorer** E-Rate schools are **less likely** than students in wealthier E-Rate schools to have access to such forms of technology resources; that is, students in the poorest E-Rate schools are estimated to have about a 23 percentage point lower probability that their school will access nongovernment technology resources than students in the wealthiest E-Rate schools, controlling for differences in school size, location, and grade level. This suggests a continuing need for targeted assistance to disadvantaged schools that, in the absence of such assistance, may be unable to achieve equitable access to educational technology.

Exhibit 5*: *Access to Nongovernment Support for Educational Technology by E-Rate Schools

Nongovernment Technology Support	**Percentage of Students in E-Rate Schools (Standard Error)**	**Regression Estimates, Statistically Significant Differences among E-Rate Schools**
School received hardware, software, or funding for educational technology from a source other than its district or the federal or state government.	37.4% (2.34)	Poverty: -22.2%*

*=p<0.05

Source: ISET survey of schools, school year 1999–00

The Role of States in Equalizing Access to Technology

This final section of chapter III looks at the role that states play in educational technology and how their activities may be related to E-Rate applications and discounts. In particular, according to a previous analysis of E-Rate administrative data from 1998 through January 2000 (Puma, Chaplin, and Pape 2000), there are substantial state-to-state variations in both the probability of applying for E-Rate and average per student discount levels. For example, the fraction of schools applying for E-Rate during the 1999–00 program year ranged from a low of 41 percent in Montana to over 90 percent in Georgia, Tennessee, Rhode Island, and Arkansas. The highest average discounts per student were found in Alaska, Kentucky, Puerto Rico, Mississippi, New Mexico, and the District of Columbia, and five states (accounting for about one-third of all public school students) received about 40 percent of total E-Rate discounts: California, New York, Texas, Illinois, and Georgia received $668 million out of $1.7 billion (39 percent) in 1998–99 and $828 million out of almost $2 billion (42 percent) in 1999–00.

A variety of factors may be driving these state-to-state differences in E-Rate participation, including variation in the size, wealth, and density of state populations (i.e., poverty and urbanization determine the program's discount rates); the market cost for E-Rate-eligible equipment and services (e.g., rural communities may face higher prices for technology goods and services and thus a greater need for E-Rate assistance); the need for high-cost building-level infrastructure (i.e., the need for relatively expensive "internal connections"—accounting for over half of all E-Rate discounts—is likely to be greater in older school buildings); and the availability of other sources of technology-related funds.

A thorough analysis of all these factors—although clearly of interest—was beyond the scope of this study. Instead, this section examines data from the ISET survey of state technology coordinators[26] that focused on state efforts to support the growth and development of educational technology in their schools, and how these policies and programs may be related to both E-Rate participation and average discount levels. These comparisons use actual E-Rate administrative data through January 2000 and state-reported data on educational technology policies and programs. No attempt has been made to control for other state characteristics.

State-Supported Infrastructure

One way states can help make educational technology more available is by lowering out-of-pocket costs for districts and schools. This approach may include direct support for the acquisition of equipment and services or various forms of technology-related technical assistance. One example is the creation of intrastate networks to electronically link educational institutions and, in some cases, to provide reduced-cost access to the Internet. The availability of such networks may reduce technology costs for districts and schools by relieving them of the need to invest their own resources to acquire network-related equipment and services (i.e., servers, routers, fiber-optic cabling), and may affect the ability of districts and schools to benefit from the E-Rate in two ways. On the one hand, the availability of state-supported network capacity may spur interest in educational technology and provide a greater incentive to seek E-Rate discounts; on the other hand, reducing technology expenditures lowers the magnitude of the E-Rate discounts districts and schools may subsequently receive.

> **State Networks**
>
> *States that have invested to provide connectivity to districts and schools have* ***higher*** *proportions of their districts applying for E-Rate discounts but* ***lower*** *average subsidies per student.*

[26] The survey included all 50 states and the District of Columbia. A total of 46 responses were received.

As shown in exhibit 6, states that have invested to provide connectivity to districts and schools do, in fact, have higher proportions of districts applying for E-Rate discounts. This is true for states that have created statewide networks linking districts and schools, provided high-speed Internet connections, or helped make electronic distance learning available to schools. It appears, therefore, that there is a positive relationship between state technology investments and district and school demand for E-Rate discounts.

However, states that have supported the creation of state technology infrastructure in these ways also appear to receive, in all but one case, lower average E-Rate discounts. While the exact cause is unknown, these relationships would seem to follow from the hypothesis that direct state investments in technology may lower district and school technology expenditures, which in turn may reduce their need for E-Rate assistance.

Two additional ways that states can potentially lower out-of-pocket costs are also shown in exhibit 6—creating consortia to aggregate purchases of hardware and software, and providing guidelines for technology-related facility design. With regard to purchasing plans, states that have provided these types of cost-saving mechanisms have lower average E-Rate discount levels, but the differences in district application rates are either small or nonexistent. State provision of facility design guidelines is related to higher application rates and either small or no differences in average E-Rate subsidies.

Another way states can support educational institutions' efforts to expand access to educational technology is through the provision of technical assistance. As shown in exhibit 6, E-Rate application rates are nearly 10 percentage points higher in states that have provided technical assistance through regional technology centers. But since this type of support is unlikely to have a significant effect on the cost of equipment and services, there is no appreciable difference in average E-Rate discount levels.

Exhibit 6*: *State Infrastructure Support and E-Rate Participation

Type of State-Provided Infrastructure	Percentage of Districts Applying for E-Rate		Average E-Rate Discount per Student	
	Yes	No	Yes	No
State provides a statewide electronic network linking at least some districts	86.3%	77.8%	$30.5	$41.8
State provides a statewide electronic network linking all or almost all districts	88.6%	79.9%	$26.3	$42.5
State network provides at least some districts and schools with high-speed Internet connections	87.2%	72.2%	$31.0	$26.0
State network provides all or almost all districts and schools with high-speed Internet connections	87.7%	85.3%	$24.5	$39.2
State makes distance learning technology[27] available to districts	84.6%	73.9%	$32.3	$45.2
State provides regional technology centers	85.9%	76.3%	$35.7	$37.1
State purchasing consortium for technology hardware	82.4%	79.7%	$33.4	$40.9
State purchasing consortium for technology software	82.0%	80.3%	$32.8	$41.5
State purchasing consortium for online services (other than E-Rate)	81.2%	81.5%	$30.3	$39.1
State guidelines for technology-related facility design: new school buildings	85.2%	75.4%	$34.4	$39.0
State guidelines for technology-related facility design: existing school buildings	87.9%	72.9%	$36.3	$36.1
State department of education applied for E-Rate discounts	85.1%	79.3%	$36.8	$36.8

Source: ISET survey of state technology coordinators and E-Rate administrative data through January 2000

[27] Includes two-way audio and video, two-way audio, one-way video, one-way live video, one-way prerecorded video, two-way audio, one-way audio, and two-way online (web-based).

Finally, a state department of education may itself apply for E-Rate discounts, presumably to help support these types of technology infrastructure investments, and this decision may affect the E-Rate participation of the state's school districts (e.g., they may get some of the support they need directly from their state agency). As shown in exhibit 6, a state's separate application for E-Rate discounts has no discernible relationship to average E-Rate discounts provided to its school districts, but the district application rate is higher in states that have themselves applied for E-Rate discounts.

State Competitions for TLCF Grants

A second area that may be related to state differences in E-Rate use is how states decided to distribute their federal TLCF funds. Although TLCF applicants were encouraged to also apply for E-Rate discounts, the availability of TLCF funding may have affected both their propensity to apply and the average discount they received if approved. This issue is examined using information from the recent study of the TLCF program (AIR 2002) in which states were categorized based on both how broadly TLCF funds are distributed within the state (the fraction of districts that are funded) and the size of the average per pupil grant. Exhibit 7 shows how the proportion of districts applying for the E-Rate, and average E-Rate discounts, differed between the two extreme TLCF categories: broad distribution of TLCF grants but relatively small average grants versus targeted distribution and relatively large average grants. As with the previous discussion, no attempt has been made to incorporate other state characteristics into this analysis.

E-Rate and TLCF

Broad *TLCF distribution is associated with a* ***higher*** *percentage of districts applying for E-Rate, while a more* ***targeted*** *distribution is associated with a* ***lower*** *percentage of districts applying for E-Rate.*

In addition, the broadest distribution of TLCF funds is related to both lower average TLCF grant awards and lower average E-Rate discounts.

As shown in exhibit 7, in states that opted for a broad distribution of TLCF funds and an associated lower average per student TLCF grant award, more districts applied for the E-Rate and the average level of E-Rate discounts was lower than in those states that chose to target their TLCF funds to a more select group of school districts. Conversely, in states with the most targeted distribution of TLCF funds, fewer districts applied for the E-Rate, and the average per student TLCF grant and E-Rate discount were higher.

Although the information needed to really understand these patterns is lacking, it may be that some combination of economic and technological need is playing an important role. That is, in states with relatively few high-need districts, targeting the TLCF funds may be a wise strategy. These same states may also have a relatively larger proportion of districts that choose to forgo the opportunity to obtain E-Rate discounts, hence the lower application rates. On the other hand, in states with a broader, less concentrated need, a strategy of "spreading the money around" may be the wise course of action. Such states are likely to have a relatively smaller proportion of districts that choose to forgo the opportunity to obtain E-Rate discounts, hence the higher application rates.

***Exhibit 7**: State TLCF Grant Competitions and the E-Rate*

	TLCF Grants		E-Rate Discounts	
1998 State TLCF Grant Competition	**Percentage of Districts Funded**	**Average Funding per Student**	**Percentage of Districts Funded**	**Average Discount per Student**
Broad distribution and smaller average grants (n=9)	Over 65%	Under $50	87.0%	$33.1
Targeted distribution and largest average grants (n=5)	Under 25%	Over $155	71.6%	$38.5

TCLF=Technology Literacy Challenge Fund
Source: TLCF administrative data for 1998 and E-Rate administrative data through January 2000

Summary

The E-Rate—the largest single public source of technology funds for schools and libraries—was intended to reduce disparities in access to 21st-century digital technology between high- and low-poverty districts and schools, as well as inequities brought about by geographic isolation. Although the data from this study do not allow comment on the benefits of expanding access to the Internet and other digital technology, it is clear that public districts and schools have taken great advantage of the E-Rate, with the largest average discounts clearly going to the most disadvantaged communities. This targeting is important because the poorest schools are also less able to access nongovernment resources for technology.

Districts that received discounts reportedly made significant changes in the availability of various types of digital technology, including number of phones per student, number of Internet-connected computers per student, number of teleconferencing links per student, fraction of buildings connected to the Internet, fraction of classrooms connected to the Internet, total number of Internet connections per student, and the highest speed of these Internet connections. But inequities still exist. In particular, students in poorer E-Rate schools and those in rural E-Rate schools are less likely to have teachers who can access their school's computer network from home, and students in larger, rural, and elementary grade E-Rate schools are less likely to have teachers who have access to an e-mail account at school.

States have played a role in helping to reduce such inequities and advance the implementation of educational technology in their schools. Such actions are also related to increasing the probability that schools will apply for, and receive, E-Rate discounts. A larger fraction of districts applied for E-Rate discounts in states that invested to expand connectivity to districts and schools, provided technical assistance through state regional technology centers, and provided guidelines for the design of school technology-related facilities. Some states have also tried to help lower the cost of technology investments, and this has helped reduce their need for E-Rate discounts—average discounts per student are lower in states that have built educational networks and states that have created purchasing consortia to help lower the cost of acquiring hardware and software.

There is also a distinct relationship between E-Rate participation and how states opt to competitively subgrant TLCF funds. A **broad** distribution of state TLCF funds is associated with a **higher** percentage of districts applying for E-Rate and lower average discounts when approved, while a more **targeted** distribution of state TLCF grants is associated with a **lower** percentage of districts applying for E-Rate and comparatively higher average per student E-Rate discounts.

Chapter IV: Are Schools Able to Use the Technology That E-Rate Supports, and How Is It Being Used?

This chapter moves from E-Rate's role in increasing equitable access to educational technology to questions about the role of E-Rate in the context of teaching and learning, focusing on two key questions:

- **Are schools able to use the technology that E-Rate supports?** That is, do schools have the resources needed to make effective use of the types of digital technology supported by E-Rate discounts? Are there variations in this ability among different types of E-Rate schools?

- **How do schools use the supported technology?** In particular, what do we know about how teachers are using E-Rate-supported digital technology in their classrooms? And again, are there variations in use among different types of E-Rate schools?

Do Schools Have the Resources to Make Effective Use of E-Rate-Supported Technology?

Applicants are expected to have the ability to effectively use the technology acquired using E-Rate discounts, including a sufficient number of computers; software to explore the Internet; technical staff to acquire, install, and maintain the equipment and services; and adequately trained teachers who can facilitate students' use of the new technology. This section examines information on some of these issues, using data from the Integrated Studies of Educational Technology (ISET) surveys.

Technology Planning

The obvious starting point for this discussion is that districts and schools that receive E-Rate discounts should have a clear plan for how the supported technology will be used for instruction. According to program guidelines, E-Rate applicants must[28] *"develop a technology plan and have it approved by an independent agency certified by the SLD"* (usually the state department of education) that *"describes how schools and libraries intend to integrate the use of these technologies into their programs or curricula."* Although the ISET surveys do not assess the quality or adequacy of these technology plans, it is clear that virtually all districts (99 percent) and schools (92

[28] Except for those entities applying only for discounted telephone service.

percent) have a written plan, whether they receive E-Rate funding or not (AIR 2002). At the school level, about half have developed a school-specific technology plan, with the remaining schools adopting a technology plan developed by their state or district (AIR 2002). Virtually all districts (98 percent) and schools (92 percent) include an objective of increasing connectivity to the Internet as one of the goals of their technology plan.

One of the concerns about the E-Rate requirement for technology plans was that it would lead to unnecessary duplication of effort and the possible proliferation of planning documents. The data show, however, that most districts and schools developed a single multipurpose technology plan rather than separate plans for E-Rate and other technology uses (AIR 2002). For example, only 4 percent of districts had a separate E-Rate technology plan (AIR 2002). There are no significant differences on any of these measures by poverty, size, urban or rural location, receipt of a Technology Literacy Challenge Fund (TLCF) grant, or type of school, controlling for the other factors.

School-Based Technology Support

Technical Support

The vast majority of public school teachers have access to technical support, but often it does not meet their needs, especially with regard to integrating technology into daily instruction.

Lack of technology support is often cited as a constraint to teachers' ability to effectively integrate the use of computers and the Internet into daily classroom instruction (SRI 2002). This support includes a range of assistance, from installing and maintaining hardware and software to dealing with day-to-day operating problems and helping teachers find ways to integrate technology into their daily lessons.

Data from the ISET surveys indicate that the vast majority of public school teachers have access to technology support, but it often does not meet their expectations. Nearly 80 percent of teachers reported having a technology coordinator at their school, and virtually all (97 percent) indicated that they have access to support for the use of hardware and networks in their schools (SRI 2002). Fewer (83 percent) indicated that help with integrating technology into instruction was available to them (SRI 2002).

Despite this widespread availability of technical assistance and the fact that eight out of 10 (79 percent) teachers indicated that their need for hardware, software, or networking support was met fairly or extremely well, only about half expressed similar satisfaction with help integrating computer activities into instruction (SRI 2002).

Examining the situation in E-Rate schools (exhibit 8), 81 percent of students in E-Rate schools have a technology coordinator at their school; for about two-thirds of these students, this is a full- or part-time paid position (data not shown in the table). Students in **elementary** E-Rate schools are **less likely** to have a school-based technology coordinator compared with students in middle and high schools (a difference of about 10 percentage points), controlling for other factors. But 76 percent of students in E-Rate schools have teachers who express concerns about the adequacy of the technical support that is being made available to them, and nearly half (47 percent) have teachers who report a lack of support from administrators for what they are trying to do with technology in their classrooms (data not shown in the table).

Exhibit 8*: *Reported Availability of School-Based Technology Technical Support, E-Rate Schools

Availability of Technical Support	Percentage of Students in E-Rate Schools (Standard error)	Regression Estimates, Statistically Significant Differences among E-Rate Schools
Teachers have a technology coordinator at their school	81.02% (1.91)	Elementary school: -11.0%***

***=p<0.01
Source: ISET survey of teachers, school year 1999–2000

Teacher Technology Skills

The effective use of educational technology also requires teachers to have both the necessary technology skills and a certain "comfort level" to make full use of what technology has to offer (Becker 2000). The extent to which this level of skill is present and sufficiently supported with ongoing professional development is discussed below from the differing perspectives of district and school staff.

As shown in exhibit 9, three-fourths of students in E-Rate districts have teachers who can use the Internet for collaboration, and virtually all are in districts that provide opportunities for teachers to participate in distance learning courses using the Internet.

Teacher Skills

The majority of students in E-Rate schools have teachers who consider themselves inadequately prepared to use technology in their classrooms.

Controlling for other factors, students in larger districts, and those in districts receiving TLCF grants, are more likely to have teachers who are provided with such opportunities, but the estimated effects are relatively small.[29]

Most students in E-Rate districts (85 percent) are in districts where inadequately trained administrators are reported to be a barrier to expanding the use of educational technology, and most (93 percent) are in districts where similar concerns have been expressed about the availability of adequately trained teachers. Students in larger E-Rate districts, with their concomitantly higher level of complexity, are more likely to be affected by such reported concerns than students in smaller E-Rate districts, controlling for other district characteristics.

Most students in E-Rate schools (58 percent) have teachers who are constrained in their efforts to effectively use educational technology for classroom instruction by a lack of training opportunities, despite the fact that the majority of students in E-Rate schools (55 to 58 percent) have teachers who received some technology-related training in the past year (data not shown in the table). Students in **larger** E-Rate schools, with their greater demands, are **more likely** than students in smaller E-Rate schools to be affected by this problem, controlling for other school characteristics.

[29] The coefficient and standard error are both very small, suggesting that the effect is close to zero. For example, an increase in enrollment of 1,000 students is associated with only a 0.02 percent change in the probability of offering opportunities for teachers to collaborate using the Internet. Most of the estimated effects for size are of this magnitude.

Exhibit 9*: *Reported Technology Skills of Teachers and Other Staff and Opportunities for Professional Development, E-Rate Districts and Schools

Source	Technology Skills and Professional Development	Percentage of Students in E-Rate Schools (Standard Error)	Regression Estimates, Statistically Significant Differences
Districts	Provide opportunities for teachers to collaborate via the Internet	75.2% (1.95)	Size: 0.02%***
	Provide opportunities for teachers to participate in distance learning courses through the Internet	95.2% (1.02)	Size: >0.00%* TLCF participant: 6.2%**
	A lack of adequately trained administrators is a barrier to the expanded use of educational technology	84.9% (1.55)	Size: 0.01%*** Urban district: 6.7%*
	A lack of adequately trained teachers is a barrier to the expanded use of educational technology	93.1% (1.12)	Size: 0.01%***
Schools	A lack of staff training opportunities affects our school's ability to effectively use educational technology	57.5% (2.44)	Size: 0.01%***
Teachers	Teachers consider themselves very well or moderately well prepared to use computers and the Internet for classroom instruction	42.6% (2.44)	Elementary school: -17.0%***
	Teachers report that their skill level with Internet browsers is at a level that they can "transform" classroom instruction	20.6% (1.88)	Poverty: -19.7%*** Elementary school: -10.4%*
	Teachers report that their skill level with E-mail is at a level that they can "transform" classroom instruction	21.2% (1.92)	Poverty: -13.7%* Elementary school: .01%**

*=p<0.10, **=p<0.05, ***=p<0.01
TLCF=Technology Literacy Challenge Fund
Source: ISET surveys of districts, schools, and teachers, school year 1999–2000

Finally, less than half of the students in E-Rate schools (about 43 percent) have teachers who feel “very well prepared” or “moderately well prepared” to use computers and the Internet for classroom instruction. Conversely, the majority of students in E-Rate schools have teachers who consider themselves inadequately prepared. Furthermore, only about one in five students in E-Rate schools have teachers who report that their skill and experience with Internet browsers and e-mail are at a level that allows them to “transform” their classroom instruction.

Students in **elementary** E-Rate schools are **less likely** than students in middle or secondary E-Rate schools to have teachers who feel well prepared to use computers and the Internet for instruction (a difference of 17 percentage points), and these students are also **less likely** to have teachers who can use the Internet or e-mail to transform instruction (by 10 percentage points for the Internet), controlling for other school characteristics. Students in **poorer** E-Rate schools are **less likely** than students in wealthier E-Rate schools to have teachers who consider themselves adept enough at Internet browsers or e-mail to be able to use it to transform their classroom instruction (differences of 20 and 14 percentage points, respectively, between the poorest and wealthiest schools), controlling for other school characteristics.

Given this general picture of how teachers perceive their preparation to use technology, it is not surprising that most students in E-Rate schools (71 percent) also have teachers who feel that a lack of adequate opportunities for professional development is a barrier to their effective use of educational technology for classroom instruction (data not shown in table). A recent examination of technology-related professional development (SRI 2002) indicated that, among the three-quarters of all teachers who received such professional development in the preceding 12 months, about two-thirds (66 percent) reported that the training included the use of e-mail; over one-third (39 percent) reported training in Web page creation; almost two-thirds (62 percent) reported training that emphasized the integration of technology into lesson plans; and about three-quarters (75 percent) reported training in the use of Internet browsers.

Student Skills

To get the most out of an enriched learning environment, students need adequate skills to use the technology that schools make available to them. According to their teachers (exhibit 10), most students in E-Rate schools (69 percent) have basic Internet skills, but students in **poorer** E-Rate schools are significantly **less likely** than students in wealthier schools to be rated by their teachers as having basic skills in this area (a 34 percentage point difference between the poorest and wealthiest schools), as are students in **elementary** E-Rate schools compared to students in middle and secondary E-Rate schools (a 42 percentage point difference), controlling for other school characteristics.

Student Skills

Most students in E-Rate schools are reported by their teachers to have basic Internet skills, but this is less likely to be reported for the poorer E-Rate schools.

Most students in E-Rate schools are also reported by their teachers to have a skill level that reduces a teacher's ability to use technology for instruction. This is especially true in poorer, urban, rural, and elementary E-Rate schools.

More important, most students in E-Rate schools (68 percent) are reported to lack the technology skills necessary to allow their teachers to effectively use technology for instruction. Controlling for other school characteristics, students in **poorer** E-Rate schools are **more likely** than students in wealthier E-Rate schools to lack the needed skills (a difference of 34 percentage points between the poorest and wealthiest schools), as are students in **urban and rural** E-Rate schools compared with students in suburban E-Rate schools (9 and 15 percentage point differences, respectively), and students in **elementary** E-Rate schools compared with students in middle and secondary E-Rate schools (by 11 percentage points).

***Exhibit 10*: Reported Student Technology Skills, E-Rate Schools**

Student Technology Skills	Percentage of Students in E-Rate Schools (Standard Error)	Regression Estimates, Statistically Significant Differences among E-Rate Schools
Most students have basic skills with Internet browsers	68.6% (2.40)	Poverty: -33.9%*** Elementary school: -41.8%***
Students' lack of needed skills to use technology is a barrier to use in the classroom	67.8% (2.34)	Poverty: 34.4%*** Urban school: 8.9%* Rural school: 14.6%** Elementary school: 11.4%**

*=p<0.10, **=p<0.05, ***=p<0.01
Source: ISET survey of teachers, school year 1999–00

Other Barriers to the Use of Technology

District technology coordinators, school principals, and classroom teachers were all asked other types of barriers to their use of educational technology. Barriers that yielded statistically significant differences among E-Rate districts and schools are presented in exhibits 11, 12, and 13.

Technology coordinators in E-Rate districts reported a broad range of factors that are constraining their ability to expand the use of educational technology in their schools. The four areas most relevant to the E-Rate are shown in exhibit 11. First, 84 percent of students in E-Rate districts are reportedly affected by an insufficient number of computers, which limits the ability of their teachers to make effective use of the digital technology that the E-Rate supports. These gaps are reportedly significantly worse for students in larger districts compared with students in smaller districts, controlling for other district characteristics.

Exhibit 11: Other Reported Barriers to the Effective Use of Educational Technology, E-Rate Districts

District-Reported Technology Barriers	Percentage of Students in E-Rate Districts (Standard Error)	Regression Estimates, Statistically Significant Differences
Insufficient number of computers	84.4% (1.75)	Size: 0.01%*** Urban district: 8.4%*
Insufficient number of peripherals	80.5% (1.84)	Size: 0.01%*** TLCF participant: 16.4%***
Internet not fast or reliable enough for use during instruction	59.9% (2.15)	Size: 0.04%***
Lack of age-appropriate or educationally relevant web sites	43.7% (2.19)	Poverty: 45.3%** Size: -0.5%***
Lack of age-appropriate or educationally relevant software	54.3% (2.18)	Size: -0.07%***
Lack of software aligned with state standards	73.5% (1.97)	Size: 0.03%***
Lack of trained staff for the acquisition of products and services	68.2% (2.04)	Size: -0.05%*** Urban district: 13.9%** Rural district: 16.7%*
Lack of trained staff for technology installation	67.2% (2.12)	Size: 0.04%*** Rural district: 13.5%**
Lack of trained staff for technology maintenance	72.1% (2.05)	Size: 0.03%***
Inadequate electrical power or wiring in school buildings	75.3% (1.94)	Size: 0.02%*** Urban district: 9.0%*
Inadequate HVAC in school buildings	60.2% (2.18)	Size: -0.00%*** Poverty: 51.0%***
Inadequate security in school buildings	51.5% (2.20)	Size: -0.04%*** Poverty: 82.0%***
Inadequate space in school buildings	86.1% (1.52)	Size: 0.02%***

*=p<0.10, **=p<0.05, ***=p<0.01
HVAC=heating, ventilation, air-conditioning
TLCF=Technology Literacy Challenge Fund
Source: ISET survey of districts, school year 1999–2000

According to SRI International (2002), classroom computer availability has increased in recent years, but the great majority of teachers (70 percent) have only one to three computers available to them. Moreover, teachers with more than one computer available in the classroom tended to have a combination of high-end (Power Mac or multimedia-capable PC) and low-end (other PC or other Macintosh) computers (SRI 2002). Access to computers in classrooms was found to differ by school level, with elementary school teachers having access to significantly more classroom computers than secondary school teachers. The proportion of secondary teachers who indicated that they had more than one computer available in their classroom was only 37 percent, compared with 70 percent of elementary teachers (SRI 2002). The additional computers in elementary school classrooms, however, are more likely to be those with limited capabilities (SRI 2002). Teachers in high-poverty schools were also found to have more low-end computers and fewer high-end computers compared with teachers in other schools (SRI 2002)

According to technology coordinators, nearly 6 out of 10 students in E-Rate districts have existing Internet connections that are too slow or unreliable for use during classroom instruction. Students in **larger** E-Rate districts, compared with students in smaller E-Rate districts, are significantly **more likely** to face this barrier, controlling for other district characteristics.

Reported Technology Barriers

District technology coordinators, school principals, and teachers all report a number of barriers to the use of technology for instruction, with significant differences by poverty, size, location, and grade level.

Other areas of concern expressed by E-Rate district staff concern the availability of technical support for the acquisition of technology equipment and services (affecting 68 percent of students), equipment installation (affecting 67 percent of students), and equipment maintenance (affecting 72 percent of students). With regard to support for acquisition, students in **larger** E-Rate districts are significantly **less likely** than students in smaller E-Rate districts to have this concern expressed by district technology coordinators, but students in **urban** E-Rate districts are **more likely** to confront this barrier than students in suburban E-Rate districts (14 percentage point difference), controlling for other district characteristics. With regard to equipment installation, students in **larger** E-Rate districts are significantly **more likely** than students in smaller E-Rate districts to face this barrier, as are students in **rural** E-Rate districts compared with those in suburban districts (by 14 and 17 percentage points, respectively), controlling for other district characteristics. Finally, the availability of staff for equipment maintenance is significantly **more likely** to confront students in **larger** E-Rate districts than those in smaller districts, controlling for other district characteristics.

A final barrier that district staff noted is the inadequacy of school building infrastructure to support the growing demands of educational technology, including available power and wiring (affecting 75 percent of students); heating, cooling, and ventilation (HVAC) systems (60 percent of students); security (52 percent of students); and space (86 percent of students). Inadequate power and wiring are significantly **greater** problems for students in **larger** E-Rate districts compared with those in smaller districts, controlling for other district characteristics. Students in **poorer** E-Rate districts are substantially **more likely** to face problems related to building security and HVAC than students in wealthier districts (a difference of 82 percentage points between the poorest and wealthiest schools), controlling for other district characteristics. Yet size is negatively related to this barrier (i.e., less of a problem in larger vs. smaller E-Rate districts), controlling for other district characteristics. Finally, building space and security are both **more likely** to be problems confronting students in **larger** E-Rate districts than students in smaller districts, controlling for other district characteristics.

School principals were asked about many of the same factors and how these factors were affecting their ability to effectively use educational technology. As shown in exhibit 12, many principals expressed concerns related to technology use, including insufficient numbers of computers (affecting 66 percent of students in E-Rate schools) and peripherals (71 percent of students), slow and/or unreliable Internet connections (44 percent of students), a lack of support staff for the maintenance of technology equipment (67 percent of students), and building-related concerns of power and wiring (55 percent of students), HVAC (42 percent of students), security (41 percent of students), and space (54 percent of students).

Statistically significant differences in these reported barriers among E-Rate schools include the following:

- **Poverty:** Students in **poorer** E-Rate schools are significantly **more likely** than students in wealthier E-Rate schools to face problems related to the availability of building security (26 percentage point difference between the poorest and wealthiest schools), controlling for other school characteristics.

- **Size:** Students in **larger** E-Rate schools are significantly **more likely** than students in smaller E-Rate schools to face problems related to the availability of computers and peripherals, building power and wiring, and building security and space, controlling for other school characteristics.

- **School type:** Compared with students in secondary E-Rate schools, students in **elementary** E-Rate schools are significantly **less likely** to face problems related to building HVAC (14 percentage points), controlling for other school characteristics.

Exhibit 12*: *Other Reported Barriers to the Effective Use of Educational Technology, E-Rate Schools

School-Reported Barriers	Percentage of Students in E-Rate Schools Facing Problem (Standard Error)	Regression Estimates, Statistically Significant Differences
Insufficient number of computers	65.9% (2.21)	Size: 0.01%***
Insufficient number of peripherals	71.0% (2.17)	Size: 0.01%*
Internet not fast or reliable enough for use during instruction	44.4% (2.35)	Urban school: 10.4%*
Lack of trained staff for technology maintenance	66.8% (2.34)	Urban school: 11.9%**
Inadequate electrical power or wiring in school buildings	55.0% (2.50)	Size: 0.01%*** Poverty: 17.4%*
Inadequate HVAC in school buildings	42.1% (2.32)	Urban school: 10.2%* Elementary school: -14.2%***
Inadequate security in school buildings	41.1% (2.21)	Size: 0.01%*** Poverty: 25.7%***
Inadequate space school buildings	54.1% (2.25)	Size: 0.01%***

*=p<0.10, **=p<0.05, ***=p<0.01

HVAC=heating, ventilation, air-conditioning

Source: ISET survey of schools, school year 1999–00

Finally, similar questions were asked of schoolteachers (see exhibit 13). The one concern that yielded significant differences among E-Rate schools, reported to affect 46 percent of students in these schools, was an inability to access web sites during the school day. Compared with students in wealthier E-Rate schools, students in **poorer** schools are significantly **more likely** to face this problem, controlling for other school characteristics (a difference of 31 percentage points between the poorest and wealthiest schools).

***Exhibit 13**: Other Reported Barriers to the Effective Use of Educational Technology, Teachers in E-Rate Schools*

Teacher-Reported Barriers	Percentage of Students in E-Rate Schools (Standard Error)	Regression Estimates, Statistically Significant Differences
Students can't access web sites during the school day	45.8% (2.18)	Poverty: 31.3%*

*=p<0.01
Source: ISET survey of teachers, school year 1999–00

Classroom Use of Educational Technology

The E-Rate provides support to install the basic infrastructure so that schools—and, most important, instructional staff—can use the Internet and other digital technology to improve the teaching and learning that takes place in America's classrooms.

Exhibit 14 examines three summary measures of the penetration of technology to the classroom level and how this penetration varies among E-Rate schools:[30]

- **Professional Use Scale—** teachers' use of technology for professional, noninstructional purposes.
- **Instructional Use Scale—** an indicator of total classroom use of educational technology.
- **Complex Use Scale—** an indicator of the extent to which teachers use technology for more complex applications during classroom instruction.

[30] For a complete definition of the three scales discussed in this section and used in exhibit 14, see SRI 2002.

These measures are discussed below.

Exhibit 14*: *Classroom Use of Technology, Teachers in E-Rate Schools

Use of Technology by Teachers	**Regression Estimates, Statistically Significant Differences among E-Rate Schools**
Professional Use Scale	Poverty: -0.566** Elementary school: -0.674***
Instructional Use Scale	Size: -0.0003** Elementary school: 0.369**
Complex Use Scale	Size: -0.0002*

*=p<0.10, **=p<0.05, ***=p<0.01
Source: ISET survey of teachers, school year 1999–00 (scales from SRI 2002)

Professional Use of Technology

Classroom Use of Technology

Students in poorer and elementary-level E-Rate schools are less likely to have teachers who use technology for professional purposes.

Students in elementary E-Rate schools are more likely to have teachers who have "higher" uses of educational technology, but this is often for drill and practice.

Students in larger E-Rate schools are less likely to have teachers who use "complex" applications of educational technology.

Teachers use of technology for professional activities is defined as use in activities that teachers engage in outside of instructional time, including creating instructional materials, lesson planning, and recordkeeping. Most teachers use computers for creating instructional materials (95 percent of teachers), lesson planning (85 percent), communicating with colleagues (79 percent), recordkeeping (71 percent), and communicating with parents (46 percent). Levels of professional use are lower in high-poverty schools (SRI 2002). Slightly more than one-fourth of teachers are considered to be "higher-end" users of technology for professional purposes (SRI 2002).

As shown in exhibit 14, students in **poorer** E-Rate schools compared with those in wealthier E-Rate schools (a 57 percentage point difference between the poorest and wealthiest schools), and those in **elementary** E-Rate schools compared with those in secondary E-Rate schools (a 67 percentage point difference), are **less likely** to have teachers who use computers and the Internet for professional (noninstructional) purposes, controlling for other school characteristics.

The percentage of teachers using technology regularly for classroom instruction appears to be growing compared with data from previous studies, but teachers' use of computers and the Internet remain relatively unsophisticated. The following activities are reported by the majority of teachers: improving students' computer skills (as a free-time or reward activity), practice drills, writing, and Internet research (SRI 2002). The most common computer applications used in classrooms (SRI 2002) are word processing (76 percent of teachers), Internet browsers (70 percent), and access to reference CD-ROMs (57 percent). Frequent use (once a week or more) is relatively uncommon, reported by about 18 percent of teachers (SRI 2002). Overall, teachers in high-poverty schools are more likely than those in low-poverty schools, and elementary school teachers more likely than secondary school teachers, to use computers for practice drills (SRI 2002).

On a scale that measures teachers' total technology use for instruction, as shown in exhibit 14, students in **larger** E-Rate schools are **less likely** than those in smaller schools to have teachers with higher levels of overall technology use in their classrooms, controlling for other school factors. On the other hand, students in **elementary** E-Rate schools are **more likely** than students in middle or secondary schools to have teachers who are higher overall users of technology, controlling for other school characteristics. But, as noted above, use in elementary schools is probably often focused on drill and practice activities.

Finally, about one-fourth of students in E-Rate schools have teachers who are "complex" technology users, which includes the use of spreadsheets and multimedia applications for instruction. As shown in exhibit 14, students in **larger** E-Rate schools are **less likely** than students in smaller schools to have teachers who are higher users of technology for more complex instructional activities.

Controlling Appropriate Use of the Internet

A final aspect of classroom use of technology is related to how districts and schools are dealing with the difficult issue of ensuring that students are using the Internet appropriately. In December 2000, Congress enacted the Children's Internet Protection Act (CIPA), which took effect on April 21, 2001. CIPA requires schools and libraries that receive federal funds for Internet access from the E-Rate or the Department of Education to enforce a policy of Internet safety for minors that includes limiting the online activities of those under age 17 through the operation of technology that prevents access to child pornography or obscene material "harmful to minors."

Internet Filters

81 percent of students are in E-Rate districts that use Internet filters to control student access to inappropriate content.

The ISET surveys were conducted after CIPA was enacted but, as shown in exhibit 15, by the 1999–2000 school year, essentially all public school districts already had some sort of policy or procedure to help protect students from inappropriate use of the Internet. Nearly all students in E-Rate districts (97 percent) were covered by policies that required "classroom management" techniques to monitor student computer and Internet use; most (87 percent) were covered by policies requiring students to sign a "contract" agreeing to use this privilege appropriately; and most (83 percent) had teachers who were offered training by their districts on the appropriate use of the Internet. Moreover, 81 percent of students in E-Rate districts were protected by the use of "filtering" software on computers. Students in **larger** E-Rate districts were **less likely** to be covered by student contracts, classroom management techniques, or filters for this purpose, but **more likely** than students in smaller E-Rate districts to have their district depend on professional development for staff, controlling for other district characteristics.

Exhibit 15: ***District Efforts to Ensure Students' Appropriate Use of Computers and the Internet***

Policies and Procedures Used by Districts to Ensure Appropriate Use of Computers and the Internet	Percentage of Students in E-Rate Schools (Standard Error)	Regression Estimates, Statistically Significant Differences
Students sign a "contract" agreeing to appropriate use	86.4% (1.30)	Size: -.00*** Poverty: 20.1%*
Teachers, librarians, or media specialists use classroom management techniques to monitor use	97.0% (0.77)	Size: -.00**
Teachers, librarians, or media specialists receive training on appropriate use of the Internet	83.2% (1.72)	Size: .00*** Poverty: 24.2%*
Filters are installed on computers	81.1% (1.72)	Size: -.00***

*=p<0.10, **=p<0.05, ***=p<0.01
Source: ISET survey of districts, school year 1999–00

Summary

A number of key themes emerge from this chapter:

- **Classroom Use of Educational Technology.** Students in poorer and elementary E-Rate schools are less likely than students in wealthier and middle and secondary E-rate schools to have teachers who are "higher" users of computers and the Internet for professional (noninstructional) purposes.

  Students in larger E-Rate schools are less likely than those in smaller schools to have teachers who are higher overall users of technology for instruction. Students in elementary E-Rate schools are more likely to have teachers who are at this level of overall use than students in middle or secondary E-Rate schools, primarily because of the frequent use of drill and practice activities in elementary schools (SRI 2002).

  About one-fourth of students in E-Rate schools have teachers who are "complex" technology users. Students in larger E-Rate schools are less likely than students in smaller schools to have a teacher rated at this level.

- **Teacher Skills and Preparation.** Students in larger E-Rate districts are more likely than students in smaller districts to be affected by reportedly inadequate teacher skills and the limited availability of training opportunities for teachers.

Further, less than half of students in E-Rate schools have teachers who consider themselves well prepared to use computers and the Internet for classroom instruction, and only 20 percent of these students have teachers who consider themselves able to use the Internet to "transform" classroom instruction. Students in poorer and elementary E-Rate schools are less likely than students in wealthier and middle and secondary schools to have teachers who rate themselves at these levels.

Seven out of 10 students in E-Rate schools have teachers who report that a lack of adequate opportunities for professional development is a barrier to their effective use of educational technology for classroom instruction.

- **Student Skills**. Most students in E-Rate schools have basic Internet skills, but students in poorer and elementary E-Rate schools are significantly less likely to have these skills. More important, nearly 7 out of 10 students in E-Rate schools are reported by their teachers to lack the skills needed to effectively use technology for classroom instruction. Again, students in poorer E-Rate schools are more likely to be considered inadequately prepared by their teachers, as are students in urban and rural (vs. suburban) and elementary schools.

- **District-Reported Technology Barriers.** More than 8 out of 10 students in E-Rate schools reportedly lack sufficient instructional computers, with the situation being significantly worse in larger E-Rate districts. Six out of 10 students in E-Rate schools have slow or unreliable Internet connections, which constrain the use of the Internet for instruction, with students in larger E-Rate districts more likely to confront this shortcoming. Many students are also reportedly constrained by a lack of technical support, with significantly greater concerns found in larger, urban, and rural (vs. suburban) E-Rate districts, depending on the type of technical staff. Finally, inadequate school buildings affect the use of educational technology for many students in E-Rate districts, including reported problems with electrical, heating, and cooling systems; security; and space. Significant differences are found by district size, poverty level, and location (i.e., urban, rural, or suburban).

- **School-Reported Technology Barriers.** E-Rate school principals expressed a number of concerns related to technology use, including insufficient numbers of computers, slow or unreliable Internet connections, a lack of maintenance support, and building-related concerns (electrical, heating, and cooling systems; security; and space). Significantly worse conditions are reported to affect students in larger, urban, and poorer E-Rate schools, depending on the particular dimension. Finally, nearly half the students in E-Rate schools are reportedly unable to access web sites during the school day, more so in poorer E-Rate schools.

Chapter V: Conclusions

Is the E-Rate Helping to Equalize Access?

Computers and the Internet have become widely available in today's public schools—most parents would be surprised not to see a computer in their child's classroom. And once-glaring differences in the availability of computers and the Internet between high- and low-poverty schools have all but disappeared. Although classroom-level Internet access is still more common in wealthy schools, classroom access in the poorest schools has increased over the past few years, after stagnating in 1998. These improvements have coincided with the commitment of nearly $8 billion in E-Rate discounts to schools and libraries between 1998 and 2001.

According to E-Rate administrative data, 84 percent of approved discounts have gone to public schools, and significantly higher discounts have been directed to poor and rural communities: Per student funding for the most disadvantaged school districts was almost 10 times higher than for the least disadvantaged districts, and higher discounts have gone to the poorest rural communities. This targeting is especially important because, as noted in this report, poorer schools that receive E-Rate discounts are less likely than their wealthier counterparts to have access to nongovernment sources of technology funds.

E-Rate applicants have also reported statistically significant increases in the availability of digital technology, including the number of schools and classrooms connected to the Internet, the speed of their Internet connections, and the number of Internet connections per student. Further, according to the ISET surveys, most students in E-Rate schools (80 percent) have teachers who have access to an e-mail account at their school, about two-thirds have teachers who are able to access their school's computer network from home, and 57 percent have teachers who can also access the Internet this way.

State agencies have played an important role in helping to expand the availability of the Internet and other digital technologies, and such leadership is associated with a higher number of districts applying for E-Rate discounts. State assistance includes support for creating educational networks that link districts and schools, providing state regional technology assistance centers, finding ways to use other technology funds (such as the Technology Literacy Challenge Fund), creating purchasing consortia to help lower the cost of acquiring hardware and software, and providing guidelines for the design of school technology-related facilities.

Are Schools Able to Use the Supported Technology?

Although public districts and schools, especially those in poor and rural communities, have been the primary beneficiaries of E-Rate support, there are significant gaps in their ability to effectively use the acquired technology for classroom instruction:

- Students in **poorer** E-Rate districts and schools are—according to district and school administrators and teachers—more likely (controlling for other factors) to face a variety of conditions that may limit the use of educational technology for instruction, including inadequate teacher skills, limitations of existing school buildings (i.e., security, space, and electrical systems), and slower and less reliable Internet connections.

- Similarly, students in **rural** E-Rate districts and schools are—according to district and school administrators and teachers—more likely (controlling for other factors) to have the use of technology for instruction limited by students' general technology skills and the availability of technical support staff. Students in **urban** E-Rate settings are, controlling for other factors, more likely to face constraints related to the adequacy of teacher and student technology skills, the availability of technical support staff, building electrical systems, and the speed and reliability of their Internet connection.

- District and school size brings with it greater organizational and technical complexity, as well as increased scale and scope of technology systems. Controlling for poverty and other characteristics, students in **larger** E-Rate districts and schools are more likely to be affected by a number of barriers to the expanded use of educational technology, including the availability of adequately trained teachers and of training opportunities for them; the availability of a sufficient number of instructional computers; teacher access to an e-mail account at school; the speed and reliability of the Internet connection; access to technical support staff; and adequacy of building space and electrical systems. Teachers in larger E-Rate schools are less likely to be "higher" overall users of educational technology or to use computers for "complex" purposes in their classrooms, controlling for other factors.

- Finally, controlling for other characteristics, students in **elementary** E-Rate schools are less likely than students in middle and secondary schools to have their use of the Internet and other digital technology constrained by the availability of technical support or the technology skills of their teacher.

Reflections on These Results

This study, conducted during the start-up years of the E-Rate, provides some evidence about the program's role in the growing penetration of technology into the nation's public schools. It is far from the last word, and many questions are left unanswered. But these data may inform some future policy decisions.

Can the Efficiency of the E-Rate Application Process Be Improved?

Because the E-Rate is a new and complex program, it is not surprising that district and school administrators have expressed some concerns about the application and approval process. These concerns include difficulty completing the application forms, delays in receiving approved discounts or reimbursements, and problems working with technology vendors. Evidence from an earlier ISET study (Puma, Chaplin, and Pape 2000) also points to lower than expected application rates among the poorest districts, suggesting that these schools may have a lower capacity to deal with the application process, as well as financial constraints that limit their ability to pay for the undiscounted cost of technology equipment and services. A more streamlined process may, therefore, be worth considering, especially for institutions that have previously received E-Rate discounts and could be handled through an expedited funding procedure.

Is Greater Flexibility Needed?

Two findings from this study suggest a need to reconsider how E-Rate discounts can be used and, more broadly, how different sources of funding for educational technology could be combined to meet the technology needs of states, districts, and schools.

During the E-Rate program's early years, over half of all discounts were used for high-cost "internal connections" related to networking and building wiring, especially the costly retrofitting of older buildings to meet the needs of modern computer technology. At some point, one would expect the need for these costly items to decrease, thereby shifting the distribution of discounts to the less costly acquisition of telephone and Internet services. Such changes may provide an opportunity to reevaluate the allowable uses of E-Rate discounts.

Findings from this and other studies indicate a significant need for technology-related resources not currently supported by the E-Rate. These resources include professional development, access to technical support (particularly that related to helping teachers better integrate the Internet and other digital technology into daily classroom life), and access to a sufficient number of advanced computers and other hardware and software. Consideration should be given to increasing the flexibility with which E-Rate discounts can be used, to better enable schools to meet the intended goal of creating technological parity.

Increased Coordination of Resources

Consideration should also be given to how the E-Rate fits into the broader picture of public and private investments in educational technology, to create a more integrated system of resources. The new Enhancing Education Through Technology (EdTech) program, included in the No Child Left Behind Act of 2001 (the reauthorization of the Elementary and Secondary Education Act of 1965), provides assistance to states for the implementation of comprehensive educational technology systems (this program replaces the TLCF). In particular, the new legislation encourages states to use other federal educational funds in flexible ways to meet their technology goals and to pursue the formation of public-private partnerships.

As evidence from this study indicates, states can and do play an important leadership role in educational technology, and this new program is an opportunity to enhance that role by helping districts and schools better coordinate federal (including E-Rate), state and local, and private resources to more effectively use technology to increase the academic achievement of all students.

Unanswered Questions

This study is only a preliminary look at the early implementation of the E-Rate and was not intended to examine the impact of the E-Rate—or digital technology in general—on instruction and learning. More information is needed about the link between E-Rate funding and the closing of the digital divide, especially about differences in the quality of the equipment and services (e.g., access to broadband Internet) that are available to poor and rural communities. In addition, more needs to be known about how E-Rate-supported technology is actually being used in schools and classrooms, and the extent to which the technology is able to transform instruction and learning, as many proponents have predicted. Finally, more information is needed about the demands that this new technology is placing on instructional and other district and school staff, and the extent to which a lack of capacity is constraining the effective use of the acquired technology.

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Appendix A: The E-Rate Program.[31]

The E-Rate was authorized by Congress as part of the Telecommunications Act of 1996, building on the goals of the 1934 Communications Act "*to make available, so far as possible, to all the people of the United States, a rapid, efficient nation-wide, and world-wide wire and radio communication service with adequate facilities at reasonable charges.*" In line with this goal, the E-Rate is intended "*to ensure that all eligible schools and libraries have affordable access to advanced telecommunications services,*"[32] building on the recommendations of the final report of the National Information Infrastructure Advisory Council (NIIAC 1995) to, among other things, "*deploy Information Superhighway access and service capabilities to all community-based institutions that serve the public, such as schools and libraries, by the year 2000.*" The E-Rate program is administered by the Schools and Libraries Division (SLD) of the Universal Service Administrative Company (USAC) under the direction of the Federal Communications Commission (FCC).

Program History

The first application period for the E-Rate began on January 30, 1998; more than 30,000 applications were submitted with requests for discounts totaling over $2 billion. The program's implementation was delayed, however, as a result of lawsuits by GTE, BellSouth, and SBC Communications (later consolidated into a single legal proceeding) that sought to block implementation of the E-Rate, claiming that the Universal Service Fund (of which E-Rate is a part) represented an illegal tax and that the FCC had unfairly excluded Internet providers from paying into the fund.

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[31] For more information on the E-Rate, see http://www.sl.universalservice.org/SLC.

[32] http://www.sl.universalservice.org/SLC/data/doc/ProgramDescriptionY5.doc.

Exhibit A-1: E-Rate Funding History as of December, 2001

	Year 1		Year 2		Year 3		Year 4	
Total Commitments ($)	$1,711,623,124	100.0%	$2,126,817,806	100.0%	$2,123,306,420	100.0%	$1,694,055,361	100.0%
(number)	24,967		29,904		26,334		25,677	
Schools	$110,166,088	6.4%	$180,336,292	8.5%	$120,444,073	5.7%	$122,848,320	7.3%
Districts	$1,283,925,951	75.0%	$1,584,078,929	74.5%	$1,732,435,357	81.6%	$1,366,322,604	80.7%
Libraries	$65,707,620	3.8%	$65,234,957	3.1%	$66,001,235	3.1%	$44,851,097	2.6%
Consortia	$251,823,465	14.7%	$297,167,628	14.0%	$204,425,755	9.6%	$160,033,341	9.4%
Funding Type								
Telecom (dedicated)	$676,025,330	39.5%	$632,258,132	29.7%	$699,662,091	33.0%	$690,567,472	40.8%
Internet	$134,293,384	7.8%	$148,729,173	7.0%	$219,959,625	10.4%	$215,731,652	12.7%
Internal connections	$901,304,409	52.7%	$1,345,830,501	63.3%	$1,203,684,704	56.7%	$787,756,237	46.5%
Location								
Urban	$454,138,979	26.5%	$1,374,300,656	64.6%	$1,313,163,533	61.8%	$1,018,084,054	60.1%
Rural	$1,040,150,487	60.8%	$490,565,390	23.1%	$550,792,611	25.9%	$300,173,648	17.7%
Unknown	$217,333,658	12.7%	$261,951,760	12.3%	$259,350,276	12.2%	$375,797,660	22.2%
Discount Band								
20–29 percent	$2,166,095	0.1%	$4,091,032	0.2%	$1,789,060	0.1%	$2,093,352	0.1%
30–39 percent	$5,708,963	0.3%	$7,400,523	0.3%	$6,514,947	0.3%	$9,609,292	0.6%
40–49 percent	$103,777,712	6.1%	$151,514,827	7.1%	$112,670,520	5.3%	$108,809,500	6.4%
50–59 percent	$105,101,960	6.1%	$191,022,989	9.0%	$114,580,863	5.4%	$120,807,301	7.1%
60–69 percent	$160,236,520	9.4%	$296,175,662	13.9%	$174,644,608	8.2%	$188,691,153	11.1%
70–79 percent	$331,744,027	19.4%	$332,094,164	15.6%	$229,288,803	10.8%	$208,000,449	12.3%
80–89 percent	$573,937,138	33.5%	$636,665,386	29.9%	$832,223,996	39.2%	$183,069,253	10.8%
90 percent	$428,950,709	25.1%	$507,853,223	23.9%	$651,593,622	30.7%	$872,975,062	51.5%

Source: SLD web site, www.sl.universalservice.org/SLC/funding, December 2001. Year 1, as of 7/17/01; Years 2 and 3, as of10/30/01; Year 4, as of 11/28/01.

Following congressional hearings and a review by the General Accounting Office (GAO 1998), the FCC decided to scale back the planned funding cap from $2.25 billion to $1.9 billion and to spread the program's initial funding over a longer "first year" period of 18 months, extending through June 1999. This lengthening of the time period was also intended to align the E-Rate with the regular school year. Concurrently, the GAO (1998) issued reports criticizing the management oversight of the program, leading to the FCC's decision to create the independent Schools and Libraries Division under USAC.

In November 1998, the first E-Rate commitments were issued; in December, the application period for Year 2 was begun (covering July 1999 through June 2000). By March 1999, the SLD had completed its first round of awards, providing around $1.7 billion to about 25,000 eligible schools and libraries (see exhibit A-1). In April 1999, the second round of applications closed with a total of close to 30,000 applicants (a 20 percent increase from the first year of the program); awards totaled $2.1 billion.

Program Operations

As shown in exhibit A-2, eligible schools and libraries may receive discounts on eligible telecommunication services ranging from 20 percent to 90 percent, depending on economic need and location (urban or rural). The level of discount (i.e., schools and libraries pay less than market cost to obtain eligible equipment and services) is based on the percentage of students eligible for participation in the National School Lunch Program or other federally approved alternative mechanisms contained in the Elementary and Secondary Education Act (ESEA). For libraries, the discount rate is based on the poverty level of the school district in which they are located.

Exhibit A-2: E-Rate Discount by Poverty Concentration and Rural Location

Poverty: Percentage of Students Eligible for Free and Reduced-Price Meals	Discount Rate: Nonrural Location (%)	Discount Rate: Rural Location (%)
Less than 1%	20	25
1–19%	40	50
20–34%	50	60
35–49%	60	70
50–74%	80	80
75–100%	90	90

The E-Rate Application Process

The E-Rate application process consists of six steps that all participants must take:

1. ***Prepare a technology plan that meets SLD criteria.*** SLD requires applicants to develop a technology plan to ensure that they have the ability to effectively use the discounted services once they are purchased. Qualifying technology plans must cover a three-year period and must specify how the entity plans to integrate the use of the acquired equipment and services into its curricula or programs. The applicant must answer the following questions: How can information technology help schools and libraries achieve a vision for an improved school or library? What telecommunications services, hardware, software, facility upgrades, maintenance, and support services will schools and libraries need to reach their goals? How will staff learn to use networked information technologies for improved education or library services? In addition to the share of discounted services, how will the entity pay for computers, training, software, and support services that the E-Rate does not cover? How will the entity know if the information technology investment is helping it reach its goals for improved education or library service? Schools and libraries must also certify that they have funds budgeted and approved to meet their financial obligations to pay for the nondiscounted portion of their requested services and to pay for the other components, set out in their technology plans, for the current funding year.

2. ***Submit a Form 470 Request for Services.*** Once a technology plan has been prepared, the next step is to notify the SLD of the services and equipment that are needed. This is done by submitting a Form 470, either in hard copy or by posting it on the SLD web site.

3. ***Select sources through a competitive bidding process.*** The submission of a Form 470 launches a 28-day competitive bidding period, during which vendors contact applicants to bid on the requested services. Entities must wait at least 28 days from the date of the Form 470 before signing any contract or making other arrangements for new services. However, applicants are expected to follow their regular state or local competitive bidding processes or timeframes.

4. ***Submit a Form 471, Services Ordered and Certification.*** After service providers have been selected and contracts signed, applicants file a Form 471 to apply for E-Rate discounts. This form may be filed as soon as the “window” for submission is opened by the SLD.

5. ***Receive notification from SLD of approved acquisitions.*** After the Form 471 application has been reviewed, the SLD issues a Funding Commitment Decision Letter, which tells applicants the level of E-Rate funding that has been allocated for E-Rate-eligible services. Each requested service is assigned a funding request number (FRN) and is approved or disapproved individually. The SLD also notifies vendors of the approved funding commitment. There are separate annual funding cycles allowing a 75–90-day window for the submission of Form 470s. Funding decisions by the SLD are made in waves within each funding cycle, beginning with the institutions that are eligible for the

highest discounts and with the most basic services (e.g., basic telephone), continuing until all requests are met or until the budget is depleted.

6. ***Implement services.*** Once the entity has received its approved services or equipment, the SLD disburses funds either directly to the vendors (who have provided the discount to the school or library) or as a reimbursement to the applicant. To get a reimbursement for approved discounts, applicants must file a Form 472, Billed Entity Applicant Reimbursement (BEAR) form. Applicants are expected to make their own arrangements with vendors regarding how the discounts will be “paid,” and only a single method may be used for a particular program year.

Appendix B: Study Methodology

Survey Development[33]

The Integrated Studies of Educational Technology (ISET) include surveys of all state technology coordinators; a stratified national probability sample of public school districts; a probability sample of schools nested within the selected district sample; and a probability sample of teachers nested within the school sample. This sampling design allows for the analysis of interrelationships of policies and programs at all levels of the education system to enhance implementation of the three separate ISET studies and reduce respondent burden.

The ISET surveys were developed jointly by the Department of Education (ED) and the three contractors. The content areas for each survey were first established, and existing instruments and data sources were examined for possible use. Although some items from other surveys were adapted for use in ISET, the majority of survey items were new, developed in an iterative, collaborative process between ED and contractor staff. Because of the nested character of the ISET data collections, surveys were reviewed to ensure that parallel questions were being posed to different respondents, enhancing the ability to triangulate across multiple data sources. All surveys were pilot tested for content and length in July through August 2000 and subsequently refined in light of feedback from pilot test respondents. The online versions of the state, district, E-Rate, and school surveys were pilot tested in September and October 2000.

Survey Administration

Data were collected from late November 2000 to June 30, 2001. The state and district surveys were initially offered only online;[34] the school survey was mailed to respondents,

[33] A copy of all survey instruments can be obtained at http://www.ed.gov/technology/iset.html.

[34] The ISET state, district, and school surveys were made available online through a Web-based survey system; potential respondents were given user IDs and passwords. The system was accessed through a link made available on the Department of Education web site. The initial mailing included a "Using the ISET Online System" manual. To help respondents use the system, two methods for obtaining help were available. A frequently asked question (FAQ) page provided answers to common questions and was accessible from each page at the click of a button. Two toll-free telephone numbers (one for the district- and the other for the school-level data collections) were provided in all contact letters, as were e-mail addresses. The 800 numbers and e-mail addresses were also displayed at the beginning and end of each online survey, as well as in the FAQ page, so users had ready access to technical support staff.
(footnote continued)

with the option to complete the survey online or on paper. Because initial response rates were low, survey administration for these samples was later modified to allow respondents to complete the survey online, on paper, or, in some cases, via a telephone interview. The teacher survey was administered only as a mail survey.

Survey of State Technology Coordinators

The state technology coordinators of all 50 states and the District of Columbia were asked to complete the survey of state technology coordinators. Initial notification letters from the Department of Education were sent in late October 2000, with an enclosed ISET informational brochure. Approximately two weeks later, state personnel were mailed a packet containing: a cover letter signed by project staff; login information and a user's guide to the ISET online system; a document request form; and a prepaid Federal Express return mailer. The state technology coordinators were asked to complete the online survey and provide copies of Technology Literacy Challenge Fund (TLCF) requests for proposals for all competitions held during the 1997–98, 1998–99, and 1999–00 school years; lists of awarded and nonawarded applicants; and a copy of the current state technology plan. A list of districts and schools sampled within the state was also enclosed, and coordinators were asked to encourage responses to the ISET data collection initiative. State technology coordinators were sent follow-up letters in early January 2001 and were contacted several times in the subsequent months by the Department of Education's TLCF program coordinator. Ultimately, 44 of the 51 state technology coordinators completed the online survey.

Survey of District Technology Coordinators

As with state technology coordinators, initial notification letters printed on Department of Education letterhead were mailed to district technology coordinators in late October, along with a copy of the ISET brochure. The survey packet followed about two weeks later, in mid-November; it contained a cover letter (and Rolodex card) with login information, a user's guide to the online system, and a list of schools that were sampled from the district (if included in the school survey). Districts were asked to complete the survey of district technology coordinators and to encourage schools that were sampled from their district to participate in ISET. A subsample of 225 districts was also notified about a future mailing that would arrive under separate cover, which would request that they complete the fiscal survey and provide a copy of their current technology plan. A $40 Amazon.com gift certificate was sent to each respondent who completed a district survey or a fiscal survey (if one person completed both surveys, he or she was given a total of $80 in gift certificates).[35]

Because of the timing of the survey, initial response rates were quite low. The survey packet arrived at district offices during the holiday season (before Thanksgiving), with the request that the survey be returned by December 31. The busy holiday season prevented many district technology coordinators from responding to the initial survey. Reminder postcards were sent on December 8 and January 2, but they had little impact on response rates. January also proved to be a less than optimal time for a survey because of the labor-intensive E-Rate applications, which were due late in the month. Follow-up phone calls began on January 22 and lasted for several weeks.

A second mailing was sent out at the end of February that consisted of: a letter from ED encouraging responses and a reiteration of the login information. For districts in the fiscal sample, a new copy of the fiscal survey was enclosed in the envelope, along with a prepaid Federal Express mailer. State technology coordinators were also enlisted to help boost response rates. By the end of April, the district completion rate was at 46 percent. An additional 22 percent had logged on to the Web-based system without completing the survey. Consequently, a reduced “critical items” version of the survey of district technology coordinators was developed in early May, and on May 18, a packet was mailed to each nonrespondent district, containing a letter on ED stationery requesting that they complete the district survey; a hard copy of the critical item version of the survey; and a prepaid Federal Express mailer.

[35] At the end of the district survey, the respondent was asked to provide an e-mail address where the gift certificate code could be sent. Awarding the gift certificates this way lowered the cost and labor involved in this aspect of the ISET study. Gift certificates for the school survey (described below) were handled the same way.

Survey of District Fiscal Coordinators

Respondent contact information was obtained by telephone from the technology coordinators in the 225 sampled districts. Unlike the other ISET surveys, the district fiscal survey was sent by e-mail to the designated participants. It could then be saved to the respondent's hard drive and completed electronically. Once completed, the survey could be e-mailed back to the contractor. In instances where e-mail addresses were unavailable, the survey was sent through the U.S. mail. Each person who completed a district fiscal survey received an Amazon.com gift certificate for $40. Despite multiple attempts to encourage survey completion, only 67 completed district fiscal surveys were received, a 30 percent response rate. These data were not, as a consequence, used for this report.

Survey of School Principals

Initial notification letters from ED indicating that the school had been selected for inclusion in ISET were mailed to the schools and districts in late October; for the subsample of schools selected for the teacher survey, the initial notification letters also included a request for teacher rosters. To ensure that the survey packets would stand out, the first mailing was done via the U.S. Postal Service's Priority Mail option. The initial mailing took place on November 29, 2000, and included a personalized letter; copies of the survey of school principals and the separate E-Rate survey module; login information and instructions for using the online system, and prepaid and addressed return envelopes. To increase the response rate, each sampled school was informed that it would receive a $20 Amazon.com gift certificate for completing the survey on paper and a $30 gift certificate for completing it online. A second mailing to nonrespondents took place on January 4, 2001; it included a letter and information for using the online system. A third mailing to nonresponding schools took place on February 23, 2001, and included a letter from ED, copies of the survey instruments, online survey information, and a prepaid return envelope.

Reminder postcards were mailed to 798 nonresponding schools on March 9, 2001, and follow-up telephone calls were made to 661 nonresponding schools beginning on April 2, 2001. The callers were instructed to first encourage the schools to return the full survey, and if the school seemed hesitant, to send the school (by fax or mail) a reduced, critical items survey. All schools were called at least once during the first week, and at least twice more during the following weeks unless the school had been sent an additional copy of the survey or the critical items. Direct contact was made with 271 principals and hundreds of assistants. A final mailing to 508 nonresponding schools took place on June 6, 2001, consisting of a letter from ED, the critical items survey form, a return envelope, and a $20 bill (rather than the promise of a gift certificate).

Survey of Classroom Teachers

Recruitment of respondents for the teacher survey began with requests for faculty rosters from the 582 schools randomly selected from the total school sample. As mentioned above, the initial request for rosters was sent with the original ED notification letters. The request for an up-to-date list of faculty with teaching assignments was made in the cover letter as well as on a separate, brightly colored insert. By December 7, 2000, only 118 rosters had been received, so staff searched school web sites to find up-to-date rosters—they found an additional 63. In early January 2001, contractor staff began an extensive round of telephone and fax follow-up to schools to increase the percentage of faculty lists received. In some cases, secretaries willingly provided a roster by fax, e-mail, or mail. In most cases, multiple phone calls and fax reminders were made to secure the list; in many cases, permission was required from principals or district administrators before a list could be released. By January 16, 2001, 323 rosters had been provided; follow-up via phone and fax reminders continued for 259 schools from which rosters had not yet been received, raising the final count to 473 rosters (81 percent) by the end of February 2001. The teacher names from these 473 schools were entered into a database; these 13,531 teachers made up the pool from which the final sample of 1,750 was drawn.

The survey of teachers was mailed to the 1,750 respondents on March 14, 2001, using U.S. Priority Mail. It included the following: a “Dear Teacher” letter on ED stationery; a brochure describing ISET; a teacher survey; a self-addressed, stamped envelope; and, a

$10 bill attached to the cover as a token of appreciation for the respondent's time. Reminder postcards were mailed on April 2, 2001. A second mailing took place on April 16 to the 872 teachers who had not yet responded; it included a cover on ISET letterhead, a copy of the survey, and a prepaid return envelope. Phone follow-up began during the week May 1 and continued for two weeks. When callers could not reach the respondent at the school (which was most cases), they left messages with secretaries or in voicemail. After two attempts had been made to contact the teacher by phone, a fax reminder was sent.

Final follow-up efforts took place during the weeks of May 29 and June 6, 2001. This follow-up focused on teachers from schools in southern states (where the school year tends to end relatively early) and on teachers in the largest urban districts (because the response rate for these districts was 58 percent at that time). For the teachers in these two categories for whom a school fax number was available (nearly all), friendly reminders were faxed to the respondent's attention.

Sampling Methodology

The ISET surveys are based on sampling districts and schools with probabilities proportional to their enrollment size; that is, larger districts and schools were given a greater probability of being selected, and smaller districts and schools had a smaller probability of being selected.

Sampling began with the selection of districts using the 1997–98 Common Core of Data Agency File as the sampling frame. Only districts in the 50 states and the District of Columbia, and those defined as "regular,"[36] were included in the frame, resulting in a total of 14,427 districts. The universe was then validated against the National Center for Education Statistics' (NCES's) *Overview of Public Elementary and Secondary Schools and Districts: School Year 1997–98, NCES 99-322* from May 1999. Data on the E-Rate recipiency of each district were developed as part of a separate ISET analysis of E-Rate administrative data (see Puma, Chaplin, and Pape 2000), and ED provided administrative data on receipt of TLCF funds.

[36] Districts that had enrollment of zero, that were not located in one of the 50 states or the District of Columbia, or that were not "regular" school districts were removed from the district sampling frame. Regular school districts were those designated as an Independent Local School District or a Union Component Local School District by NCES. Supervisory Union Administrative Centers, Regional Education Service Agencies, State-Operated Institutions, Federally Operated Institutions, and Other Education Agencies were not included in the sampling frame.
(footnote continued)

Poverty data were also provided by ED, using census data and 1994–95 NCES codes. Missing values for poverty were imputed using predicted values from an Ordinary Least Squares (OLS) regression model.[37]

The districts were divided into six "super-strata" on the basis of their E-Rate and TLCF status and their poverty status. Super-strata 1 through 5 are defined as follows:

<table>
<tr><th></th><th colspan="2">E-Rate</th><th colspan="2">Non-E-Rate</th></tr>
<tr><th></th><th>TLCF</th><th>Non-TLCF</th><th>TLCF</th><th>Non-TLCF</th></tr>
<tr><td>High-Poverty District</td><td>2</td><td>3</td><td colspan="2" rowspan="2">1</td></tr>
<tr><td>Districts in Other Poverty Levels</td><td>4</td><td>5</td></tr>
</table>

Super-stratum 6 was selected first, to be composed of the 60 largest districts, all classified as being in a "large central city." The total number of schools in each stratum was validated against NCES's *Overview of Public Elementary and Secondary Schools and District: School Year 1997-98, NCES 99-322* from May 1999.

Districts were selected first with probabilities proportional to the size of the district. The district measure of size was the total enrollment for the district divided by the total enrollment for the super-stratum from which it was selected, multiplied by the number of districts selected in that super-stratum.

Schools were then selected within sampled districts, also using probabilities proportional to size, but here the selection process incorporated the probability that a particular district was selected in the first stage. In other words, the school measure of size is the probability that the school is selected, given that its district is selected. Therefore, the overall probability that a school was sampled to be part of the ISET study is the product of the district measure of size and the school measure of size.

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[37] District poverty is based on the following 1990 U.S. census data: the fraction of students in the district eligible for free or reduced-price lunches, the fraction minority, urban location, and district size.

It is important to remember that the super-strata are based on district and not school characteristics. Systematic sampling was used, however, based on school characteristics (poverty, urban location, and size). This approach does not affect the calculation of school weights because it does not affect the probability of any individual school being sampled. Instead, systematic sampling increases the probability of having a good distribution of schools based on the characteristics chosen.

A subsample of schools was then selected for the teacher survey. These schools were not selected with probabilities proportional to size; instead, a specified number of schools were selected from each stratum. Thus, the overall probability that a school was sampled to be part of the ISET teacher study is the product of the district measure of size, the school measure of size, and the probability that the school was selected to be in the teacher survey.

Finally, once the rosters were collected from the sampled schools, a random sample of teachers was selected from each school. Approximately equal numbers of teachers were selected from each sampled school, with the exception of schools in super-stratum 6, which were allocated slightly larger sample sizes.

Sampling Weights

Sampling weights, used to estimate population statistics from the selected samples, are the inverse of the probability of selection at each level (e.g., district, school, and teacher).[38] For the results discussed in this report, district-, school-, and teacher-level data were weighted to the total number of students in public schools. These weights for districts were the product of the district enrollment and the inverse of the district measure of size. Weights for the total number of students in a school (i.e., school and teacher data) are the product of the total school enrollment and the inverse of the school measure of size.

[38] Because the survey of state technology coordinators and the district fiscal survey involved such limited numbers of respondents, no weights or nonresponse adjustments were made for these datasets.

Nonresponse Adjustments

The basic sampling weights were adjusted to account for survey nonresponse. For districts, the response rate within each sampling stratum was calculated, and this quantity was then multiplied by the probability of selection for each district. For example, if the response rate is 80 percent for a stratum, and the probability of selection of a district is 0.9, the adjusted probability of selection is (0.8)(0.9) = 0.72. The weight for this district is (1/0.72) rather than (1/0.9); that is, the weight adjusted for nonresponse is larger than the unadjusted one. Response rates for districts in the certainty sample (super-stratum 6, consisting of large urban districts) were computed in a slightly different way, because this is a self-representing sample. Response rates for these districts were calculated by dividing [the total number of students in the certainty sample districts that responded] by [the total number of students in the certainty sample of districts]. For example, if there are five districts in the certainty sample, the number of students in those five districts is A. If only three of those five districts respond, the number of students in the three districts is B. The response rate is computed as (B/A). The adjusted weight is therefore 1/(B/A).

For the school survey, the weights were adjusted for nonresponse by calculating response rates by strata and school size categories and then dividing the sampling weights by these probabilities. For super-stratum 6, the bottom two size categories were combined. For the student-level weights, response rates were multiplied by the school's probability of selection (which was proportional to school size); for the school-level weights, response rates were weighted by the number of schools each school represents in the sample.

After teachers were selected from their school rosters, they were classified into the following mutually exclusive categories: first grade, second grade, third grade, fourth grade, fifth grade, sixth grade, seventh grade, eighth grade, English, math, science, and history or social studies. Weights for the teacher sample were used to estimate the following quantities:

- the number of eligible teachers by super-stratum and the percentage distribution across super-strata;
- the number of eligible teachers in elementary schools and in secondary schools and the percentage of eligible teachers in each of these types of schools; and
- the number of eligible teachers by teacher classification and the percentage distribution

across teacher classifications.

The weights for teachers who responded to the teacher survey were summed by super-stratum, elementary or secondary school classification, and teacher classification, so that the distributions across these variables could be compared with the distribution in the universe before nonresponse adjustment (the distributions were quite similar). The largest absolute difference in distribution was in super-stratum 4, which was 29 percent of the universe of eligible teachers and 32 percent of the respondents. The largest relative difference in distribution was in super-stratum 6, which was 12 percent of the universe of eligible teachers and 10 percent of the respondents. All differences for the elementary or secondary school and teacher classification categories were less than these values in absolute and relative terms.

Weights were adjusted for nonresponse by ranking the weights of the respondents so that they equaled the number of eligible teachers by super-stratum, school level, and teacher classification. Because the percentage distributions in the universe and the sample matched very closely, the adjustments to the weights were modest (ranging from an increase by a factor of 1.22 to an increase by a factor of 2.02). The average adjustment was an increase by a factor of 1.52 (reflecting the fact that the sum of the unadjusted weights of the respondents was 2.144 million and the total number of eligible teachers in the universe was 2.363 million).

Replicate Weights and Variance Estimation

The sampling weights adjusted for nonresponse were used to calculate replicate weights to estimate appropriate sampling variances for subsequent hypothesis testing, taking into account the clustering of observations within districts (or schools, in super-stratum 6). The replicate weights were created using the Jack knife N (Jkn) method in WesVar, with the primary sampling units (PSUs) being the districts for super-strata 1 through 5, and the schools for super-stratum 6 (the stratum in which all possible districts were included in the sample). For the school survey, the school data were treated as if the PSUs with at least some responding schools were all of the districts in the sample. Therefore, the variance estimates for schools will be somewhat biased, because some sampled PSUs had no schools that responded. WesVar can control for this but not when using the Jkn method. The variance estimates are also biased, because a large fraction of the population in super-stratum 6 was sampled. WesVar can correct for this using the finite population correction (Fpc); however, using Fpc with Jkn would have caused an underestimate of the variance. Alternatively, not using Fpc causes an overestimation of the variance. This results in conservative confidence regions and reduces the likelihood of statistically significant results. For districts, a similar procedure was used, except that the PSU was always defined as the district, and districts in super-stratum 6 are treated as self-representing.

Using WesVar and the Jkn method, one replicate weight variable was generated for each PSU, resulting in hundreds of replicate weight variables for each of the survey datasets. In order to save on storage space, 60 replicate weight variables were randomly selected from the full set created by WesVar. This method retains unbiased and reasonably precise estimates while greatly saving on storage space.[39] WesVar was used for all analyses discussed in this report.

[39] Brick, J. M., Broene. P., Ferraro, D., Hankins, T., Rauch, C., Strickler, T. *Technical Report No. 4: 1999 Variance Estimation*, National Survey of America's Families, 1999 Methodology Series. (The Urban Institute, Washington, D.C., November 2000).

Appendix C: Detailed Regression Tables

This appendix provides the detailed regression results discussed in this report. Statistical tables are organized hierarchically: district data first, then school data, and finally teacher data. Separate regressions are presented first using all respondents (to test for differences between E-Rate and non-E-Rate participants), and second using only E-Rate participants (to test for differences among participants). The first set of regressions (between participants and nonparticipants) was briefly discussed at the start of chapter III, while the second (among participants) is the basis for most of the results discussed in this report.

Table titles provide a shortened version of the questionnaire item that served as the dependent measure in each of the regressions. For exact wording, see Department of Education (ED) 2002, which includes copies of all Integrated Studies of Educational Technology (ISET) questionnaires. In most cases, the dependent variables are dichotomous (0,1) variables, indicating that the respondent either did (1=yes) or did not (0=no) report the particular response. In addition, two versions of a district E-Rate participation variable—continuous and dichotomous—were tested, but the results presented here are for the continuous measure as described in chapter II. The results were not qualitatively different for the two variables.

District Regressions: All Districts

District has a technology plan

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.9780	0.0178	55.0021	0.000
% Students in E-Rate Schools	0.0162	0.0242	0.6705	0.503
Percent Poverty	-0.0431	0.0331	-1.3031	0.193
Total Enrollment/1000	0.0000	0.0000	1.4524	0.147
Urban	-0.0059	0.0142	-0.4185	0.676
Rural	-0.0017	0.0119	-0.1414	0.888
TLCF Participant, 1997, 1998	0.0085	0.0142	0.5995	0.549
R_SQUARE VALUE =	0.0056			

District provides opportunities for teachers to collaborate via the internet

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6526	0.0727	8.9798	0.000
% Students in E-Rate Schools	0.0507	0.0735	0.6903	0.490
Percent Poverty	0.0529	0.1645	0.3218	0.748
Total Enrollment/1000	0.0002	0.0000	6.2542	0.000
Urban	0.0122	0.0565	0.2152	0.830
Rural	-0.0482	0.0540	-0.8929	0.372
TLCF Participant, 1997, 1998	0.0650	0.0456	1.4266	0.154
R_SQUARE VALUE =	0.0399			

District provides opportunities for teachers to participate in courses via distance learning

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.9364	0.0388	24.1383	0.000
% Students in E-Rate Schools	-0.0211	0.0426	-0.4938	0.622
Percent Poverty	-0.0663	0.0821	-0.8085	0.419
Total Enrollment/1000	0.0000	0.0000	1.8504	0.065
Urban	0.0207	0.0312	0.6633	0.507
Rural	-0.0066	0.0295	-0.2231	0.824
TLCF Participant, 1997, 1998	0.0628	0.0253	2.4785	0.013
R_SQUARE VALUE =	0.0275			

Barriers to expanded use of educational technology: insufficient number of computers

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.7751	0.0564	13.7410	0.000
% Students in E-Rate Schools	-0.0334	0.0622	-0.5363	0.592
Percent Poverty	0.0581	0.1379	0.4213	0.674
Total Enrollment/1000	0.0001	0.0000	2.8609	0.004
Urban	0.0886	0.0489	1.8130	0.070
Rural	0.0280	0.0471	0.5935	0.553
TLCF Participant, 1997, 1998	0.0614	0.0394	1.5565	0.120
R_SQUARE VALUE =	0.0342			

Barriers to expanded use of educational technology: insufficient number of peripheral devices

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.7302	0.0610	11.9798	0.000
% Students in E-Rate Schools	-0.0568	0.0654	-0.8679	0.386
Percent Poverty	0.1714	0.1471	1.1648	0.245
Total Enrollment/1000	0.0001	0.0000	3.5348	0.000
Urban	-0.0042	0.0512	-0.0815	0.935
Rural	-0.0540	0.0501	-1.0779	0.281
TLCF Participant, 1997, 1998	0.1597	0.0418	3.8205	0.000
R_SQUARE VALUE =	0.0683			

Barriers to expanded use of educational technology: insufficient number of other types of technology

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6770	0.0661	10.2429	0.000
% Students in E-Rate Schools	-0.0549	0.0694	-0.7907	0.429
Percent Poverty	0.5038	0.1619	3.1109	0.002
Total Enrollment/1000	-0.0007	0.0000	-19.0781	0.000
Urban	-0.0134	0.0552	-0.2430	0.808
Rural	-0.0928	0.0526	-1.7639	0.078
TLCF Participant, 1997, 1998	0.1540	0.0440	3.4957	0.001
R_SQUARE VALUE =	0.1083			

Barriers to expanded use of educational technology: Internet connection not fast or reliable enough for use in instruction

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5818	0.0739	7.8673	0.000
% Students in E-Rate Schools	-0.0090	0.0758	-0.1192	0.905
Percent Poverty	-0.0971	0.1795	-0.5407	0.589
Total Enrollment/1000	0.0004	0.0000	8.9995	0.000
Urban	-0.0310	0.0607	-0.5109	0.610
Rural	-0.0640	0.0578	-1.1068	0.269
TLCF Participant, 1997, 1998	0.0690	0.0489	1.4101	0.159
R_SQUARE VALUE =	0.0431			

Barriers to expanded use of educational technology: lack of age-appropriate or educationally-relevant web sites

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.4683	0.0757	6.1841	0.000
% Students in E-Rate Schools	-0.0489	0.0782	-0.6250	0.532
Percent Poverty	0.4417	0.1807	2.4449	0.015
Total Enrollment/1000	-0.0005	0.0000	-11.5468	0.000
Urban	-0.0248	0.0634	-0.3917	0.695
Rural	0.0131	0.0586	0.2236	0.823
TLCF Participant, 1997, 1998	-0.0404	0.0500	-0.8083	0.419
R_SQUARE VALUE =	0.0587			

Barriers to expanded use of educational technology: lack of age-appropriate or educationally-relevant software

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.4824	0.0751	6.4271	0.000
% Students in E-Rate Schools	0.0311	0.0772	0.4024	0.688
Percent Poverty	0.2162	0.1844	1.1721	0.242
Total Enrollment/1000	-0.0007	0.0000	-14.0809	0.000
Urban	0.0339	0.0641	0.5285	0.597
Rural	0.0775	0.0580	1.3350	0.182
TLCF Participant, 1997, 1998	0.0125	0.0493	0.2529	0.800
R_SQUARE VALUE =	0.0782			

Barriers to expanded use of educational technology: lack of software aligned with state standards

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6475	0.0698	9.2803	0.000
% Students in E-Rate Schools	-0.0423	0.0691	-0.6114	0.541
Percent Poverty	0.2311	0.1596	1.4481	0.148
Total Enrollment/1000	0.0003	0.0000	6.2107	0.000
Urban	0.0349	0.0555	0.6294	0.529
Rural	0.0262	0.0532	0.4913	0.623
TLCF Participant, 1997, 1998	0.0541	0.0451	1.2003	0.230
R_SQUARE VALUE =	0.0401			

Barriers to expanded use of educational technology: lack of trained staff for product/service acquisition

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.4997	0.0735	6.8031	0.000
% Students in E-Rate Schools	0.0712	0.0742	0.9598	0.338
Percent Poverty	0.1318	0.1688	0.7804	0.435
Total Enrollment/1000	-0.0005	0.0000	-11.7421	0.000
Urban	0.1309	0.0586	2.2332	0.026
Rural	0.1533	0.0517	2.9646	0.003
TLCF Participant, 1997, 1998	0.0653	0.0449	1.4550	0.146
R_SQUARE VALUE =	0.0649			

Barriers to expanded use of educational technology: lack of trained staff for technology installation

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5617	0.0744	7.5448	0.000
% Students in E-Rate Schools	0.0085	0.0761	0.1123	0.911
Percent Poverty	0.0058	0.1843	0.0315	0.975
Total Enrollment/1000	0.0004	0.0000	8.3851	0.000
Urban	0.0804	0.0627	1.2823	0.200
Rural	0.1221	0.0551	2.2178	0.027
TLCF Participant, 1997, 1998	0.0065	0.0473	0.1371	0.891
R_SQUARE VALUE =	0.0398			

Barriers to expanded use of educational technology: lack of trained staff for maintenance

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6280	0.0723	8.6876	0.000
% Students in E-Rate Schools	0.0345	0.0741	0.4658	0.642
Percent Poverty	-0.0437	0.1808	-0.2417	0.809
Total Enrollment/1000	0.0003	0.0000	7.6992	0.000
Urban	0.0973	0.0603	1.6131	0.107
Rural	0.0769	0.0543	1.4158	0.157
TLCF Participant, 1997, 1998	-0.0242	0.0459	-0.5275	0.598
R_SQUARE VALUE =	0.0333			

Barriers to expanded use of educational technology: school building electric power/wiring

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5870	0.0722	8.1257	0.000
% Students in E-Rate Schools	0.0801	0.0730	1.0980	0.273
Percent Poverty	0.1163	0.1553	0.7490	0.454
Total Enrollment/1000	0.0002	0.0000	5.4213	0.000
Urban	0.0891	0.0533	1.6733	0.095
Rural	-0.0188	0.0532	-0.3531	0.724
TLCF Participant, 1997, 1998	0.0561	0.0448	1.2522	0.211
R_SQUARE VALUE =	0.0558			

Barriers to expanded use of educational technology: school building HVAC

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5328	0.0741	7.1934	0.000
% Students in E-Rate Schools	-0.0340	0.0772	-0.4405	0.660
Percent Poverty	0.5081	0.1826	2.7829	0.006
Total Enrollment/1000	0.0003	0.0000	6.8259	0.000
Urban	0.0181	0.0633	0.2863	0.775
Rural	-0.0473	0.0581	-0.8141	0.416
TLCF Participant, 1997, 1998	-0.0243	0.0490	-0.4963	0.620
R_SQUARE VALUE =	0.0516			

Barriers to expanded use of educational technology: school building security

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.4196	0.0754	5.5679	0.000
% Students in E-Rate Schools	-0.0061	0.0783	-0.0780	0.938
Percent Poverty	0.8377	0.1889	4.4340	0.000
Total Enrollment/1000	-0.0004	0.0000	-9.0470	0.000
Urban	0.0666	0.0644	1.0331	0.302
Rural	-0.0921	0.0597	-1.5428	0.123
TLCF Participant, 1997, 1998	-0.0269	0.0503	-0.5357	0.592
R_SQUARE VALUE =	0.0543			

Barriers to expanded use of educational technology: school building space

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.8188	0.0547	14.9684	0.000
% Students in E-Rate Schools	0.0729	0.0561	1.2987	0.195
Percent Poverty	-0.0859	0.1140	-0.7541	0.451
Total Enrollment/1000	0.0002	0.0000	5.3266	0.000
Urban	0.0414	0.0397	1.0413	0.298
Rural	-0.0646	0.0426	-1.5178	0.130
TLCF Participant, 1997, 1998	-0.0153	0.0351	-0.4356	0.663
R_SQUARE VALUE =	0.0345			

Barriers to expanded use of educational technology: lack of adequately trained administrators

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.7373	0.0610	12.0850	0.000
% Students in E-Rate Schools	0.1122	0.0637	1.7601	0.079
Percent Poverty	-0.0911	0.1279	-0.7124	0.476
Total Enrollment/1000	0.0001	0.0000	3.2351	0.001
Urban	0.0662	0.0385	1.7173	0.086
Rural	-0.0123	0.0436	-0.2812	0.779
TLCF Participant, 1997, 1998	0.0095	0.0360	0.2630	0.793
R_SQUARE VALUE =	0.0235			

District Regressions: All Districts

Barriers to expanded use of educational technology: lack of adequately trained teachers

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.9058	0.0394	22.9739	0.000
% Students in E-Rate Schools	0.0218	0.0400	0.5451	0.586
Percent Poverty	-0.1033	0.0953	-1.0840	0.279
Total Enrollment/1000	0.0001	0.0000	3.3694	0.001
Urban	0.0386	0.0274	1.4081	0.160
Rural	-0.0118	0.0326	-0.3627	0.717
TLCF Participant, 1997, 1998	0.0115	0.0249	0.4609	0.645
R_SQUARE VALUE =	0.0153			

District promotes student use of computers

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.8183	0.0585	13.9856	0.000
% Students in E-Rate Schools	0.0466	0.0554	0.8414	0.400
Percent Poverty	-0.2880	0.1222	-2.3562	0.019
Total Enrollment/1000	0.0002	0.0000	7.0885	0.000
Urban	0.0427	0.0444	0.9609	0.337
Rural	0.0106	0.0435	0.2435	0.808
TLCF Participant, 1997, 1998	-0.0028	0.0364	-0.0760	0.939
R_SQUARE VALUE =	0.0204			

Policy to ensure appropriate use of computers: student contracts

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.9361	0.0376	24.8981	0.000
% Students in E-Rate Schools	-0.0745	0.0377	-1.9772	0.048
Percent Poverty	0.2097	0.1061	1.9761	0.049
Total Enrollment/1000	-0.0007	0.0000	-22.3464	0.000
Urban	-0.0203	0.0428	-0.4738	0.636
Rural	0.0310	0.0318	0.9741	0.330
TLCF Participant, 1997, 1998	0.0084	0.0296	0.2847	0.776
R_SQUARE VALUE =	0.2019			

Policy to ensure appropriate use of computers: classroom management techniques

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	1.0036	0.0170	59.0703	0.000
% Students in E-Rate Schools	-0.0532	0.0215	-2.4810	0.013
Percent Poverty	0.0420	0.0590	0.7114	0.477
Total Enrollment/1000	0.0000	0.0000	2.3102	0.021
Urban	-0.0116	0.0226	-0.5115	0.609
Rural	-0.0027	0.0181	-0.1507	0.880
TLCF Participant, 1997, 1998	0.0083	0.0180	0.4595	0.646
R_SQUARE VALUE =	0.0100			

Policy to ensure appropriate use of computers: professional development for staff

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.7700	0.0585	13.1702	0.000
% Students in E-Rate Schools	-0.0319	0.0616	-0.5170	0.605
Percent Poverty	0.2113	0.1390	1.5207	0.129
Total Enrollment/1000	0.0002	0.0000	4.8902	0.000
Urban	0.0054	0.0518	0.1044	0.917
Rural	-0.0029	0.0462	-0.0622	0.950
TLCF Participant, 1997, 1998	0.0546	0.0409	1.3366	0.182
R_SQUARE VALUE =	0.0297			

Policy to ensure appropriate use of computers: filters

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.8454	0.0536	15.7728	0.000
% Students in E-Rate Schools	-0.0449	0.0578	-0.7764	0.438
Percent Poverty	0.0508	0.1466	0.3463	0.729
Total Enrollment/1000	-0.0001	0.0000	-3.9564	0.000
Urban	-0.0098	0.0489	-0.2005	0.841
Rural	-0.0456	0.0466	-0.9782	0.328
TLCF Participant, 1997, 1998	0.0362	0.0382	0.9487	0.343
R_SQUARE VALUE =	0.0075			

District Regressions: E-Rate Only

District has a technology plan

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.9914	0.0071	139.0911	0.000
Percent Poverty	-0.0290	0.0279	-1.0374	0.300
Total Enrollment/1000	0.0000	0.0000	1.2827	0.200
Urban	-0.0119	0.0132	-0.9016	0.368
Rural	-0.0031	0.0104	-0.2956	0.768
TLCF Participant, 1997, 1998	0.0128	0.0135	0.9472	0.344
R_SQUARE VALUE =	0.0071			

District provides opportunities for teachers to collaborate via the internet

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6912	0.0520	13.2951	0.000
Percent Poverty	0.0521	0.1706	0.3055	0.760
Total Enrollment/1000	0.0002	0.0000	6.2106	0.000
Urban	0.0092	0.0580	0.1589	0.874
Rural	-0.0506	0.0562	-0.9006	0.368
TLCF Participant, 1997, 1998	0.0725	0.0465	1.5602	0.119
R_SQUARE VALUE =	0.0404			

District provides opportunities for teachers to participate in courses via distance learning

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.9168	0.0283	32.3832	0.000
Percent Poverty	-0.0570	0.0843	-0.6755	0.500
Total Enrollment/1000	0.0000	0.0000	1.9099	0.057
Urban	0.0199	0.0317	0.6261	0.531
Rural	-0.0037	0.0307	-0.1203	0.904
TLCF Participant, 1997, 1998	0.0619	0.0258	2.3980	0.017
R_SQUARE VALUE =	0.0269			

Barriers to expanded use of educational technology: insufficient number of computers

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.7510	0.0472	15.9177	0.000
Percent Poverty	0.0752	0.1399	0.5375	0.591
Total Enrollment/1000	0.0001	0.0000	2.7438	0.006
Urban	0.0836	0.0502	1.6660	0.096
Rural	0.0235	0.0493	0.4770	0.634
TLCF Participant, 1997, 1998	0.0575	0.0409	1.4056	0.160
R_SQUARE VALUE =	0.0338			

Barriers to expanded use of educational technology: insufficient number of peripheral devices

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6864	0.0496	13.8337	0.000
Percent Poverty	0.1785	0.1502	1.1881	0.235
Total Enrollment/1000	0.0001	0.0000	3.4280	0.001
Urban	-0.0144	0.0524	-0.2752	0.783
Rural	-0.0616	0.0522	-1.1803	0.238
TLCF Participant, 1997, 1998	0.1635	0.0429	3.8086	0.000
R_SQUARE VALUE =	0.0719			

Barriers to expanded use of educational technology: insufficient number of other types of technology

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6295	0.0525	11.9899	0.000
Percent Poverty	0.5226	0.1649	3.1693	0.002
Total Enrollment/1000	-0.0007	0.0000	-19.0467	0.000
Urban	-0.0212	0.0566	-0.3744	0.708
Rural	-0.0980	0.0546	-1.7962	0.073
TLCF Participant, 1997, 1998	0.1571	0.0451	3.4850	0.001
R_SQUARE VALUE =	0.1132			

District Regressions: E-Rate Only

Barriers to expanded use of educational technology: Internet connection not fast or reliable enough for use in instruction

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5713	0.0566	10.0909	0.000
Percent Poverty	-0.0716	0.1840	-0.3895	0.697
Total Enrollment/1000	0.0004	0.0000	8.9282	0.000
Urban	-0.0376	0.0625	-0.6015	0.548
Rural	-0.0636	0.0602	-1.0569	0.291
TLCF Participant, 1997, 1998	0.0682	0.0505	1.3511	0.177
R_SQUARE VALUE =	0.0441			

Barriers to expanded use of educational technology: lack of age-appropriate or educationally-relevant web sites

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.4312	0.0579	7.4477	0.000
Percent Poverty	0.4534	0.1858	2.4398	0.015
Total Enrollment/1000	-0.0005	0.0000	-11.1938	0.000
Urban	-0.0385	0.0652	-0.5915	0.554
Rural	0.0202	0.0611	0.3307	0.741
TLCF Participant, 1997, 1998	-0.0463	0.0516	-0.8973	0.370
R_SQUARE VALUE =	0.0617			

Barriers to expanded use of educational technology: lack of age-appropriate or educationally-relevant software

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5151	0.0579	8.8928	0.000
Percent Poverty	0.2079	0.1887	1.1015	0.271
Total Enrollment/1000	-0.0007	0.0000	-13.8501	0.000
Urban	0.0179	0.0658	0.2713	0.786
Rural	0.0712	0.0604	1.1794	0.239
TLCF Participant, 1997, 1998	0.0206	0.0508	0.4045	0.686
R_SQUARE VALUE =	0.0808			

Barriers to expanded use of educational technology: lack of software aligned with state standards

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6213	0.0549	11.3167	0.000
Percent Poverty	0.2049	0.1635	1.2534	0.211
Total Enrollment/1000	0.0003	0.0000	6.2516	0.000
Urban	0.0261	0.0568	0.4589	0.647
Rural	0.0273	0.0553	0.4927	0.622
TLCF Participant, 1997, 1998	0.0586	0.0464	1.2627	0.207
R_SQUARE VALUE =	0.0395			

Barriers to expanded use of educational technology: lack of trained staff for product/service acquisition

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5527	0.0563	9.8141	0.000
Percent Poverty	0.1348	0.1728	0.7799	0.436
Total Enrollment/1000	-0.0005	0.0000	-11.8243	0.000
Urban	0.1388	0.0602	2.3041	0.022
Rural	0.1607	0.0541	2.9723	0.003
TLCF Participant, 1997, 1998	0.0712	0.0463	1.5379	0.125
R_SQUARE VALUE =	0.0680			

Barriers to expanded use of educational technology: lack of trained staff for technology installation

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5650	0.0563	10.0441	0.000
Percent Poverty	-0.0115	0.1884	-0.0608	0.952
Total Enrollment/1000	0.0004	0.0000	8.3506	0.000
Urban	0.0881	0.0645	1.3662	0.172
Rural	0.1345	0.0573	2.3465	0.019
TLCF Participant, 1997, 1998	0.0090	0.0489	0.1831	0.855
R_SQUARE VALUE =	0.0427			

District Regressions: E-Rate Only

Barriers to expanded use of educational technology: lack of trained staff for maintenance

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6566	0.0531	12.3734	0.000
Percent Poverty	-0.0383	0.1842	-0.2078	0.836
Total Enrollment/1000	0.0003	0.0000	7.6007	0.000
Urban	0.0968	0.0621	1.5594	0.119
Rural	0.0781	0.0565	1.3835	0.167
TLCF Participant, 1997, 1998	-0.0218	0.0475	-0.4593	0.646
R_SQUARE VALUE =	0.0335			

Barriers to expanded use of educational technology: school building electric power/wiring

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6542	0.0540	12.1153	0.000
Percent Poverty	0.1140	0.1595	0.7147	0.475
Total Enrollment/1000	0.0002	0.0000	5.4076	0.000
Urban	0.0901	0.0546	1.6508	0.099
Rural	-0.0164	0.0554	-0.2952	0.768
TLCF Participant, 1997, 1998	0.0561	0.0460	1.2195	0.223
R_SQUARE VALUE =	0.0520			

Barriers to expanded use of educational technology: school building HVAC

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5095	0.0576	8.8391	0.000
Percent Poverty	0.5097	0.1871	2.7241	0.007
Total Enrollment/1000	-0.0003	0.0000	6.8560	0.000
Urban	0.0222	0.0651	0.3419	0.733
Rural	-0.0394	0.0622	-0.6511	0.515
TLCF Participant, 1997, 1998	-0.0377	0.0606	-0.7462	0.456
R_SQUARE VALUE =	0.0526			

Barriers to expanded use of educational technology: school building security

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.4178	0.0585	7.1410	0.000
Percent Poverty	0.8195	0.1931	4.2432	0.000
Total Enrollment/1000	-0.0004	0.0000	-8.7889	0.000
Urban	0.0675	0.0662	1.0183	0.309
Rural	-0.0785	0.0622	-1.2620	0.207
TLCF Participant, 1997, 1998	-0.0322	0.0519	-0.6191	0.536
R_SQUARE VALUE =	0.0517			

Barriers to expanded use of educational technology: school building space

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.8783	0.0381	23.0677	0.000
Percent Poverty	-0.1200	0.1160	-1.0343	0.301
Total Enrollment/1000	0.0002	0.0000	5.2802	0.000
Urban	0.0559	0.0409	1.3650	0.173
Rural	-0.0540	0.0443	-1.2187	0.223
TLCF Participant, 1997, 1998	-0.0158	0.0361	-0.4374	0.662
R_SQUARE VALUE =	0.0317			

Barriers to expanded use of educational technology: lack of adequately trained administrators

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.8278	0.0448	18.4587	0.000
Percent Poverty	-0.0806	0.1293	-0.6231	0.533
Total Enrollment/1000	0.0001	0.0000	2.9948	0.003
Urban	0.0673	0.0390	1.7250	0.085
Rural	-0.0132	0.0456	-0.2903	0.772
TLCF Participant, 1997, 1998	0.0172	0.0370	0.4640	0.643
R_SQUARE VALUE =	0.0166			

District Regressions: E-Rate Only

Barriers to expanded use of educational technology: lack of adequately trained teachers

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.9299	0.0311	29.9438	0.000
Percent Poverty	-0.0970	0.0970	-0.9994	0.318
Total Enrollment/1000	0.0001	0.0000	3.3311	0.001
Urban	0.0322	0.0273	1.1817	0.238
Rural	-0.0144	0.0339	-0.4269	0.670
TLCF Participant, 1997, 1998	0.0097	0.0256	0.3763	0.707
R_SQUARE VALUE =	0.0136			

District promotes student use of computers

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.8631	0.0395	21.8315	0.000
Percent Poverty	-0.3303	0.1252	-2.6377	0.009
Total Enrollment/1000	0.0002	0.0000	7.1564	0.000
Urban	0.0512	0.0458	1.1175	0.264
Rural	0.0193	0.0452	0.4279	0.669
TLCF Participant, 1997, 1998	-0.0055	0.0380	-0.1453	0.885
R_SQUARE VALUE =	0.0217			

Policy to ensure appropriate use of computers: student contracts

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.8746	0.0369	23.7113	0.000
Percent Poverty	0.2011	0.1096	1.8354	0.067
Total Enrollment/1000	-0.0007	0.0000	-21.6634	0.000
Urban	-0.0196	0.0444	-0.4427	0.658
Rural	0.0426	0.0333	1.2781	0.202
TLCF Participant, 1997, 1998	0.0017	0.0306	0.0548	0.956
R_SQUARE VALUE =	0.2025			

Policy to ensure appropriate use of computers: classroom management techniques

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.9640	0.0236	40.8587	0.000
Percent Poverty	0.0381	0.0602	0.6326	0.527
Total Enrollment/1000	0.0000	0.0000	2.4698	0.014
Urban	-0.0152	0.0235	-0.6489	0.517
Rural	-0.0039	0.0190	-0.2052	0.838
TLCF Participant, 1997, 1998	0.0041	0.0185	0.2247	0.822
R_SQUARE VALUE =	0.0037			

Policy to ensure appropriate use of computers: professional development for staff

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.7424	0.0477	15.5519	0.000
Percent Poverty	0.2420	0.1416	1.7092	0.088
Total Enrollment/1000	0.0002	0.0000	4.7908	0.000
Urban	0.0021	0.0527	0.0389	0.969
Rural	0.0001	0.0479	0.0028	0.998
TLCF Participant, 1997, 1998	0.0506	0.0419	1.2080	0.227
R_SQUARE VALUE =	0.0307			

Policy to ensure appropriate use of computers: filters

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.8109	0.0480	16.9027	0.000
Percent Poverty	0.0286	0.1502	0.1907	0.849
Total Enrollment/1000	-0.0001	0.0000	-3.8666	0.000
Urban	-0.0074	0.0503	-0.1478	0.883
Rural	-0.0407	0.0488	-0.8328	0.405
TLCF Participant, 1997, 1998	0.0348	0.0394	0.8840	0.377
R_SQUARE VALUE =	0.006586			

School Regressions: All Schools

School has a technology plan

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.924	0.0522	17.71	0.000
E-rate participant	0.0096	0.0367	0.2625	0.793
School poverty	-0.0745	0.0485	-1.534	0.126
Total Enrollment	0	0	1.0124	0.312
Urban	-0.0275	0.0332	-0.8282	0.408
Rural	-0.0031	0.029	-0.1068	0.915
Elementary School	0.0194	0.0258	0.7509	0.453
R_SQUARE VALUE =	0.0094			

A goal of plan is to increase connectivity to Internet

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.929	0.034	27.3552	0.000
E-rate participant	0.0006	0.03	0.0209	0.983
School poverty	-0.0455	0.0458	-0.9941	0.321
Total Enrollment	0	0	0.5792	0.563
Urban	0.0157	0.0269	0.5844	0.559
Rural	0.017	0.0317	0.5341	0.594
Elementary School	-0.0365	0.0265	-1.3758	0.169
R_SQUARE VALUE =	0.009			

School received non-government or district support for educational technology

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.499	0.0913	5.4678	0.000
E-rate participant	-0.1043	0.0699	-1.4911	0.136
School poverty	-0.2215	0.0892	-2.4827	0.013
Total Enrollment	0	0.0001	0.607	0.544
Urban	0.1219	0.0923	1.3199	0.187
Rural	-0.0082	0.0628	-0.1307	0.896
Elementary School	0.0354	0.07	0.506	0.613
R_SQUARE VALUE =	0.0135			

Barrier to effective use of educational technology: insufficient number of computers

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.4701	0.0856	5.4935	0.000
E-rate participant	0.0822	0.0684	1.2016	0.230
School poverty	0.0963	0.0855	1.1257	0.261
Total Enrollment	0.0001	0	2.8822	0.004
Urban	0.0072	0.054	0.1341	0.893
Rural	-0.0318	0.0593	-0.5364	0.592
Elementary School	0.0123	0.0509	0.2416	0.809
R_SQUARE VALUE =	0.0204			

Barrier to effective use of educational technology: insufficient number of peripheral devices

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5949	0.0857	6.9413	0.000
E-rate participant	0.0598	0.0645	0.9282	0.354
School poverty	0.0885	0.0835	1.0595	0.290
Total Enrollment	0.0001	0	1.4379	0.151
Urban	0.0072	0.0512	0.1414	0.888
Rural	-0.023	0.0599	-0.3831	0.702
Elementary School	-0.0277	0.0508	-0.5465	0.585
R_SQUARE VALUE =	0.0125			

School Regressions: All Schools

Barrier to effective use of educational technology: insufficient number of other technology

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5096	0.0915	5.5689	0.000
E-rate participant	0.0589	0.0671	0.8773	0.381
School poverty	0.1433	0.0904	1.5856	0.113
Total Enrollment	0	0	0.5518	0.581
Urban	0.0253	0.0585	0.4324	0.666
Rural	0.0302	0.0616	0.4895	0.625
Elementary School	-0.0653	0.0514	-1.2717	0.204
R_SQUARE VALUE =	0.0115			

Barrier to effective use of educational technology: Internet not fast or reliable enough for instruction

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.3918	0.0907	4.3201	0.000
E-rate participant	0.0005	0.0628	0.0072	0.994
School poverty	0.0028	0.09	0.0313	0.975
Total Enrollment	0	0	-0.261	0.794
Urban	0.1133	0.0559	2.0283	0.043
Rural	0.0079	0.0628	0.1261	0.900
Elementary School	0.0396	0.0535	0.7392	0.460
R_SQUARE VALUE =	0.0142			

Barrier to effective use of educational technology: lack of age-appropriate or educationally-relevant web sites

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.1826	0.0808	2.2597	0.024
E-rate participant	0.0597	0.0534	1.1188	0.264
School poverty	0.0969	0.085	1.1395	0.255
Total Enrollment	0	0	0.9899	0.323
Urban	-0.0812	0.0521	-1.558	0.120
Rural	0.0444	0.063	0.704	0.482
Elementary School	0.0982	0.0504	1.9484	0.052
R_SQUARE VALUE =	0.019			

Barrier to effective use of educational technology: lack of age-appropriate or educationally-relevant software

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.3659	0.0908	4.0307	0.000
E-rate participant	0.0951	0.0624	1.5232	0.128
School poverty	0.0822	0.0905	0.9092	0.364
Total Enrollment	0	0	-0.1994	0.842
Urban	0.02	0.0575	0.3482	0.728
Rural	0.0123	0.0655	0.1876	0.851
Elementary School	0.052	0.052	0.9998	0.318
R_SQUARE VALUE =	0.0115			

Barrier to effective use of educational technology: lack of software aligned with state standards

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5691	0.0905	6.2894	0.000
E-rate participant	0.053	0.0645	0.8221	0.411
School poverty	0.1414	0.0882	1.6038	0.109
Total Enrollment	0	0	-0.7386	0.461
Urban	0.0567	0.055	1.0301	0.303
Rural	0.0039	0.0636	0.0609	0.951
Elementary School	-0.0371	0.0513	-0.7231	0.470
R_SQUARE VALUE =	0.0128			

School Regressions: All Schools

Barrier to effective use of educational technology: lack of trained technical staff, product/service acquisition

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6393	0.0912	7.0114	0.000
E-rate participant	-0.0553	0.062	-0.8917	0.373
School poverty	0.1386	0.0899	1.5411	0.124
Total Enrollment	0	0	-0.1011	0.920
Urban	0.0383	0.0555	0.6912	0.490
Rural	-0.0104	0.0638	-0.1637	0.870
Elementary School	-0.0541	0.0524	-1.0328	0.302
R_SQUARE VALUE =	0.0098			

Barrier to effective use of educational technology: lack of trained technical staff, installation

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6516	0.0896	7.2738	0.000
E-rate participant	-0.0702	0.0633	-1.1079	0.268
School poverty	0.0724	0.0905	0.8002	0.424
Total Enrollment	0	0	0.292	0.770
Urban	0.0482	0.0546	0.8817	0.378
Rural	0.0013	0.0625	0.0215	0.983
Elementary School	-0.0569	0.0504	-1.1292	0.259
R_SQUARE VALUE =	0.009			

Barrier to effective use of educational technology: lack of trained technical staff, maintenance

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6762	0.0843	8.0192	0.000
E-rate participant	-0.0483	0.0574	-0.8421	0.400
School poverty	0.0865	0.0854	1.0132	0.311
Total Enrollment	0	0	-0.1767	0.860
Urban	0.1254	0.0508	2.4671	0.014
Rural	0.0461	0.0624	0.7391	0.460
Elementary School	-0.0647	0.0488	-1.3238	0.186
R_SQUARE VALUE =	0.0206			

Barrier to effective use of educational technology: lack of administrative support

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.1907	0.0801	2.3813	0.018
E-rate participant	0.0962	0.0501	1.9228	0.055
School poverty	0.0882	0.075	1.1771	0.240
Total Enrollment	0	0	0.1538	0.878
Urban	-0.0275	0.052	-0.5282	0.598
Rural	-0.0503	0.0542	-0.9281	0.354
Elementary School	-0.0768	0.0455	-1.6889	0.092
R_SQUARE VALUE =	0.0135			

Barrier to effective use of educational technology: lack of adequately trained teachers

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.7429	0.0872	8.515	0.000
E-rate participant	-0.0448	0.0611	-0.733	0.464
School poverty	0.0341	0.0842	0.4054	0.685
Total Enrollment	0	0	0.7097	0.478
Urban	0.0474	0.0483	0.9807	0.327
Rural	-0.0759	0.0613	-1.2381	0.216
Elementary School	-0.0114	0.0469	-0.2431	0.808
R_SQUARE VALUE =	0.0173			

Barrier to effective use of educational technology: lack of staff training opportunities

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5471	0.0857	6.3839	0.000
E-rate participant	-0.0348	0.0631	-0.5518	0.581
School poverty	0.0314	0.0915	0.3433	0.732
Total Enrollment	0.0001	0	1.463	0.144
Urban	0.0669	0.0571	1.1719	0.242
Rural	0.0588	0.0648	0.9078	0.364
Elementary School	-0.0456	0.0516	-0.8847	0.377
R_SQUARE VALUE =	0.0116			

Barrier to effective use of educational technology: inadequate school building space

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.3969	0.0885	4.4831	0.000
E-rate participant	0.0508	0.0666	0.7632	0.446
School poverty	0.0589	0.0865	0.6813	0.496
Total Enrollment	0.0001	0	2.1033	0.036
Urban	0.0826	0.0542	1.5252	0.128
Rural	0.0094	0.0602	0.1566	0.876
Elementary School	-0.0496	0.0523	-0.9488	0.343
R_SQUARE VALUE =	0.0233			

Barrier to effective use of educational technology: inadequate school building electric power/wiring

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.2933	0.0887	3.308	0.001
E-rate participant	0.078	0.0653	1.1954	0.232
School poverty	0.1717	0.0905	1.8973	0.058
Total Enrollment	0.0001	0	2.847	0.005
Urban	0.0858	0.0579	1.4814	0.139
Rural	0.0565	0.0652	0.8662	0.387
Elementary School	-0.0417	0.0523	-0.7964	0.426
R_SQUARE VALUE =	0.0367			

Barrier to effective use of educational technology: inadequate school building HVAC

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.3495	0.0858	4.0757	0.000
E-rate participant	0.0597	0.0589	1.015	0.311
School poverty	0.1176	0.0893	1.3178	0.188
Total Enrollment	0	0	0.234	0.815
Urban	0.0983	0.0516	1.9038	0.057
Rural	0.0235	0.0613	0.3834	0.702
Elementary School	-0.1384	0.0494	-2.8009	0.005
R_SQUARE VALUE =	0.0299			

Barrier to effective use of educational technology: inadequate school building security

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.1953	0.0861	2.2682	0.024
E-rate participant	0.0752	0.0625	1.2045	0.229
School poverty	0.2174	0.0878	2.4748	0.014
Total Enrollment	0.0001	0	2.4743	0.014
Urban	0.0359	0.0538	0.6681	0.504
Rural	0.0126	0.0582	0.2168	0.828
Elementary School	-0.0577	0.0498	-1.1575	0.248
R_SQUARE VALUE =	0.0341			

School Regressions: E-Rate Only

School has a technology plan

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.9461	0.0286	33.061	0.000
School Poverty	-0.0787	0.0519	-1.516	0.130
Total Enrollment	0	0	0.5787	0.563
Urban	-0.0192	0.0327	-0.5866	0.558
Rural	-0.0066	0.0316	-0.2083	0.835
Elementary School	0.0091	0.026	0.3507	0.726
R_SQUARE VALUE =	0.0077			

A goal of plan is to increase connectivity to Internet

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.9199	0.0341	27.0124	0.000
School Poverty	-0.0121	0.0481	-0.2511	0.802
Total Enrollment	0	0	0.7951	0.427
Urban	0.0125	0.0289	0.433	0.665
Rural	0.0123	0.0348	0.3538	0.724
Elementary School	-0.0421	0.0286	-1.4708	0.142
R_SQUARE VALUE =	0.0089			

School received non-government or district support for educational technology

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.3979	0.0789	5.0414	0.000
School Poverty	-0.2277	0.0992	-2.2951	0.022
Total Enrollment	0	0.0001	0.5079	0.612
Urban	0.1258	0.0996	1.2627	0.207
Rural	0.0155	0.0679	0.2282	0.820
Elementary School	0.023	0.0771	0.2989	0.765
R_SQUARE VALUE =	0.0105			

Barrier to effective use of educational technology: insufficient number of computers

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5194	0.0718	7.2315	0.000
School Poverty	0.0952	0.0925	1.0288	0.304
Total Enrollment	0.0001	0	3.4067	0.001
Urban	0.0131	0.0567	0.2306	0.818
Rural	-0.018	0.0639	-0.2822	0.778
Elementary School	0.0286	0.0545	0.5248	0.600
R_SQUARE VALUE =	0.0226			

Barrier to effective use of educational technology: insufficient number of peripheral devices

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.627	0.0754	8.3116	0.000
School Poverty	0.0935	0.0909	1.0283	0.304
Total Enrollment	0.0001	0	1.7836	0.075
Urban	0.0102	0.0541	0.1879	0.851
Rural	-0.0221	0.0648	-0.341	0.733
Elementary School	-0.0141	0.0543	-0.2601	0.795
R_SQUARE VALUE =	0.0154			

School Regressions: E-Rate Only

Barrier to effective use of educational technology: insufficient number of other technology

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5602	0.0811	6.9109	0.000
School Poverty	0.1578	0.0982	1.6074	0.109
Total Enrollment	0	0	0.7608	0.447
Urban	0.0129	0.0619	0.2082	0.835
Rural	0.0121	0.0665	0.1815	0.856
Elementary School	-0.0594	0.0548	-1.0831	0.279
R_SQUARE VALUE =	0.0108			

Barrier to effective use of educational technology: Internet not fast or reliable enough for instruction

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.3922	0.0866	4.529	0.000
School Poverty	-0.0215	0.099	-0.2169	0.828
Total Enrollment	0	0	0.0207	0.984
Urban	0.1041	0.0595	1.7506	0.081
Rural	0.0027	0.0676	0.0397	0.968
Elementary School	0.0452	0.0574	0.7875	0.431
R_SQUARE VALUE =	0.012			

Barrier to effective use of educational technology: lack of age-appropriate or educationally-relevant web sites

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.2612	0.0846	3.0894	0.002
School Poverty	0.0432	0.0923	0.4684	0.640
Total Enrollment	0	0	0.8814	0.378
Urban	-0.0735	0.0562	-1.3083	0.191
Rural	0.0478	0.0686	0.6968	0.486
Elementary School	0.0928	0.0546	1.6978	0.090
R_SQUARE VALUE =	0.0142			

Barrier to effective use of educational technology: lack of age-appropriate or educationally-relevant software

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.4408	0.0889	4.957	0.000
School Poverty	0.0857	0.1002	0.8549	0.393
Total Enrollment	0	0	0.25	0.803
Urban	0.0224	0.0613	0.3655	0.715
Rural	0.0116	0.0714	0.1621	0.871
Elementary School	0.0549	0.0557	0.9857	0.325
R_SQUARE VALUE =	0.0068			

Barrier to effective use of educational technology: lack of software aligned with state standards

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6163	0.087	7.0799	0.000
School Poverty	0.145	0.0971	1.493	0.136
Total Enrollment	0	0	-0.4166	0.677
Urban	0.0587	0.0588	0.9978	0.319
Rural	-0.015	0.0692	-0.217	0.828
Elementary School	-0.0392	0.0548	-0.7156	0.475
R_SQUARE VALUE =	0.0121			

School Regressions: E-Rate Only

Barrier to effective use of educational technology: lack of trained technical staff, product/service acquisition

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5676	0.0854	6.6499	0.000
School Poverty	0.1183	0.0996	1.1881	0.235
Total Enrollment	0	0	0.4629	0.644
Urban	0.0306	0.0596	0.5131	0.608
Rural	-0.0195	0.0688	-0.2832	0.777
Elementary School	-0.0427	0.0567	-0.7539	0.451
R_SQUARE VALUE =	0.0084			

Barrier to effective use of educational technology: lack of trained technical staff, installation

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5843	0.0807	7.2418	0.000
School Poverty	0.0384	0.0991	0.3871	0.699
Total Enrollment	0	0	0.5639	0.573
Urban	0.0432	0.0583	0.7406	0.459
Rural	-0.0035	0.0673	-0.0518	0.959
Elementary School	-0.0548	0.0542	-1.01	0.313
R_SQUARE VALUE =	0.0074			

Barrier to effective use of educational technology: lack of trained technical staff, maintenance

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6295	0.0789	7.9749	0.000
School Poverty	0.0527	0.0946	0.5575	0.577
Total Enrollment	0	0	0.1549	0.877
Urban	0.1189	0.0548	2.1719	0.030
Rural	0.037	0.0674	0.5489	0.583
Elementary School	-0.0581	0.0526	-1.1033	0.270
R_SQUARE VALUE =	0.0169			

Barrier to effective use of educational technology: lack of administrative support

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.2749	0.0793	3.4646	0.001
School Poverty	0.1049	0.0815	1.2876	0.198
Total Enrollment	0	0	0.4113	0.681
Urban	-0.0363	0.0561	-0.6462	0.518
Rural	-0.074	0.0584	-1.2681	0.205
Elementary School	-0.0669	0.0493	-1.3572	0.175
R_SQUARE VALUE =	0.0127			

Barrier to effective use of educational technology: lack of adequately trained teachers

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.7026	0.0795	8.8337	0.000
School Poverty	0.0062	0.095	0.0657	0.948
Total Enrollment	0	0	1.1265	0.260
Urban	0.0191	0.0524	0.3639	0.716
Rural	-0.1042	0.0662	-1.5747	0.116
Elementary School	0.001	0.0501	0.0199	0.984
R_SQUARE VALUE =	0.021			

School Regressions: E-Rate Only

Barrier to effective use of educational technology: lack of training opportunities

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5145	0.0808	6.3689	0.000
School Poverty	0.0351	0.1018	0.3447	0.730
Total Enrollment	0.0001	0	1.7746	0.076
Urban	0.031	0.0616	0.5024	0.616
Rural	0.0177	0.0702	0.2518	0.801
Elementary School	-0.0283	0.0552	-0.5121	0.609
R_SQUARE VALUE =	0.0093			

Barrier to effective use of educational technology: inadequate school building space

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.4497	0.0762	5.9029	0.000
School Poverty	0.0651	0.0928	0.7022	0.483
Total Enrollment	0.0001	0	1.9286	0.054
Urban	0.0911	0.057	1.5967	0.111
Rural	0.0007	0.0646	0.0107	0.992
Elementary School	-0.0563	0.056	-1.0052	0.315
R_SQUARE VALUE =	0.0256			

Barrier to effective use of educational technology: inadequate school building electric power/wiring

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.3432	0.0804	4.2671	0.000
School Poverty	0.1742	0.0987	1.7653	0.078
Total Enrollment	0.0001	0	3.3447	0.001
Urban	0.0745	0.0617	1.2074	0.228
Rural	0.0627	0.0707	0.8862	0.376
Elementary School	-0.0367	0.0562	-0.6536	0.514
R_SQUARE VALUE =	0.0418			

Barrier to effective use of educational technology: inadequate school building HVAC

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.3965	0.0793	5.0001	0.000
School Poverty	0.1227	0.0978	1.255	0.210
Total Enrollment	0	0	0.4634	0.643
Urban	0.1023	0.0549	1.8653	0.063
Rural	0.0313	0.0661	0.4736	0.636
Elementary School	-0.1415	0.0531	-2.6653	0.008
R_SQUARE VALUE =	0.0315			

Barrier to effective use of educational technology: inadequate school building security

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.2417	0.0746	3.2417	0.001
School Poverty	0.2574	0.0959	2.6842	0.008
Total Enrollment	0.0001	0	2.9126	0.004
Urban	0.0271	0.057	0.4758	0.634
Rural	-0.0019	0.0627	-0.0305	0.976
Elementary School	-0.0518	0.0535	-0.9683	0.333
R_SQUARE VALUE =	0.0418			

Teacher Regressions: All Schools

Most students have basic skills with the Internet browsers

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.9958	0.0549	18.1282	0.000
E-Rate School	0.0673	0.0395	1.7032	0.089
School Poverty	-0.3463	0.077	-4.4993	0.000
Total Enrollment	0	0	-0.5907	0.555
Urban	-0.0854	0.0519	-1.646	0.101
Rural	-0.0408	0.0571	-0.714	0.476
Elementary School	-0.4256	0.0397	-10.7276	0.000
R_SQUARE VALUE =	0.2857			

Have access to school computer network from home

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.7183	0.1056	6.8016	0.000
E-Rate School	0.0838	0.0742	1.1292	0.260
School Poverty	-0.234	0.0878	-2.6658	0.008
Total Enrollment	-0.0001	0.0001	-1.0308	0.303
Urban	0.0524	0.0526	0.997	0.319
Rural	-0.1212	0.0657	-1.8438	0.066
Elementary School	-0.0611	0.0589	-1.0378	0.300
R_SQUARE VALUE =	0.0293			

Have access to Internet from home through school network

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.667	0.0831	8.0284	0.000
E-Rate School	0.0162	0.0575	0.2816	0.778
School Poverty	-0.1724	0.08	-2.1542	0.032
Total Enrollment	0	0	-0.9599	0.338
Urban	0.057	0.0539	1.0561	0.292
Rural	-0.1321	0.0634	-2.0828	0.038
Elementary School	-0.0113	0.0476	-0.2381	0.812
R_SQUARE VALUE =	0.0232			

Have access to telephone in school

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.8995	0.0616	14.6061	0.000
E-Rate School	-0.0265	0.0418	-0.6347	0.526
School Poverty	-0.0329	0.0679	-0.4854	0.628
Total Enrollment	0	0	0.6786	0.498
Urban	-0.0773	0.0427	-1.8096	0.071
Rural	-0.0541	0.042	-1.2896	0.198
Elementary School	-0.0291	0.0379	-0.7673	0.443
R_SQUARE VALUE =	0.0149			

Have access to E-mail account at school

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	1.0917	0.0658	16.5931	0.000
E-Rate School	-0.0035	0.0441	-0.0796	0.937
School Poverty	-0.0882	0.0719	-1.2262	0.221
Total Enrollment	-0.0001	0	-3.6464	0.000
Urban	-0.0472	0.0416	-1.1341	0.258
Rural	-0.138	0.0543	-2.5392	0.012
Elementary School	-0.1773	0.043	-4.1267	0.000
R_SQUARE VALUE =	0.0579			

There's a technology coordinator at school

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.8479	0.0699	12.1246	0.000
E-Rate School	0.0476	0.0549	0.8675	0.386
School Poverty	-0.0324	0.0699	-0.4643	0.643
Total Enrollment	0	0	-0.0808	0.936
Urban	0.0192	0.0495	0.3891	0.697
Rural	-0.0392	0.0591	-0.6629	0.508
Elementary School	-0.1106	0.0413	-2.6809	0.008
R_SQUARE VALUE =	0.0223			

Teacher Regressions: All Schools

Barrier to use of educational technology: student's can't access web sites during school day

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.3626	0.0996	3.6398	0.000
E-Rate School	-0.0175	0.0748	-0.2339	0.815
School Poverty	0.2869	0.0851	3.3711	0.001
Total Enrollment	0	0	0.7099	0.478
Urban	-0.0446	0.0533	-0.8374	0.403
Rural	0.0309	0.0627	0.4933	0.622
Elementary School	0.0202	0.0599	0.3373	0.736
R_SQUARE VALUE =	0.0198			

Barrier to use of educational technology: Internet connection isn't fast enough for use while teaching

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.5724	0.0931	6.146	0.000
E-Rate School	0.0411	0.0686	0.5991	0.549
School Poverty	0.0981	0.0978	1.003	0.317
Total Enrollment	0	0	-0.2681	0.789
Urban	-0.0574	0.0594	-0.9665	0.334
Rural	-0.0807	0.0643	-1.2547	0.210
Elementary School	0.0164	0.0549	0.2984	0.766
R_SQUARE VALUE =	0.0071			

Barrier to use of educational technology: Internet connection isn't reliable enough for use while teaching

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.4977	0.1018	4.891	0.000
E-Rate School	0.0089	0.0774	0.1147	0.909
School Poverty	0.0186	0.0927	0.2006	0.841
Total Enrollment	0.0001	0.0001	1.2286	0.220
Urban	-0.0546	0.0585	-0.9337	0.351
Rural	-0.0257	0.0655	-0.3926	0.695
Elementary School	0.0823	0.0602	1.3676	0.172
R_SQUARE VALUE =	0.0098			

Barrier to use of educational technology: inadequate technical support

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6556	0.1224	5.3587	0.000
E-Rate School	-0.0114	0.087	-0.1316	0.895
School Poverty	0.055	0.0872	0.6312	0.528
Total Enrollment	0	0.0001	0.6913	0.490
Urban	-0.0343	0.0498	-0.69	0.491
Rural	0.0257	0.0633	0.4066	0.685
Elementary School	0.1121	0.0698	1.6051	0.109
R_SQUARE VALUE =	0.0154			

Barrier to use of educational technology: lack of support from administrators

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.3612	0.1029	3.5094	0.001
E-Rate School	-0.0403	0.0736	-0.547	0.585
School Poverty	0.0936	0.0884	1.0593	0.290
Total Enrollment	0.0001	0	1.7572	0.080
Urban	-0.0423	0.0534	-0.7922	0.429
Rural	0.0551	0.0594	0.9279	0.354
Elementary School	0.0953	0.0581	1.6395	0.102
R_SQUARE VALUE =	0.0131			

Barrier to use of educational technology: inadequate training opportunities

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6125	0.1251	4.8962	0.000
E-Rate School	0.0036	0.0849	0.0421	0.966
School Poverty	0.0043	0.1016	0.042	0.967
Total Enrollment	0	0.0001	0.5045	0.614
Urban	0.0038	0.0565	0.0675	0.946
Rural	0.0707	0.0704	1.0039	0.316
Elementary School	0.0673	0.0742	0.9075	0.365
R_SQUARE VALUE =	0.0064			

Barrier to use of educational technology: Students don't have need technology skills

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.406	0.105	3.8661	0.000
E-Rate School	0.0084	0.0767	0.1089	0.913
School Poverty	0.3466	0.0896	3.8679	0.000
Total Enrollment	0	0	1.0533	0.293
Urban	0.0705	0.0473	1.4907	0.137
Rural	0.1055	0.0583	1.8107	0.071
Elementary School	0.108	0.0429	2.5189	0.012
R_SQUARE VALUE =	0.0676			

I consider myself well prepared to use computers and the Internet for instruction

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.495	0.0906	5.463	0.000
E-Rate School	0.1053	0.0578	1.8232	0.069
School Poverty	-0.1439	0.0865	-1.6642	0.097
Total Enrollment	-0.0001	0.0001	-1.2411	0.215
Urban	0.0291	0.0539	0.5405	0.589
Rural	0.0136	0.0588	0.2319	0.817
Elementary School	-0.1655	0.0587	-2.8169	0.005
R_SQUARE VALUE =	0.0354			

My skill with Internet browsers is at the "transformation" level.

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.2949	0.079	3.7325	0.000
E-Rate School	0.0756	0.0457	1.6533	0.099
School Poverty	-0.1855	0.0685	-2.7069	0.007
Total Enrollment	-0.0001	0	-1.3141	0.190
Urban	0.0038	0.0372	0.1018	0.919
Rural	-0.0333	0.0472	-0.7049	0.481
Elementary School	-0.0963	0.0541	-1.78	0.076
R_SQUARE VALUE =	0.0322			

My skill with e-mail programs is at the "transformation" level.

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.3308	0.0925	3.5751	0.000
E-Rate School	0.0265	0.0641	0.4137	0.679
School Poverty	-0.1284	0.0702	-1.8301	0.068
Total Enrollment	-0.0001	0	-2.0571	0.040
Urban	-0.0103	0.0454	-0.2259	0.821
Rural	0.0363	0.0539	0.6735	0.501
Elementary School	-0.0647	0.0545	-1.1872	0.236
R_SQUARE VALUE =	0.0313			

My skill with Web page creation programs is at the "transformation" level.

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.0673	0.0313	2.1529	0.032
E-Rate School	-0.0014	0.0227	-0.0617	0.951
School Poverty	-0.0226	0.0215	-1.0497	0.295
Total Enrollment	0	0	-0.7991	0.425
Urban	-0.0135	0.0128	-1.0572	0.291
Rural	-0.0148	0.0191	-0.7753	0.439
Elementary School	-0.0249	0.0159	-1.5708	0.117
R_SQUARE VALUE =	0.009			

SRI (2002) Computer Availability Scale

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	1.7847	0.1402	12.7286	0.000
E-Rate School	0.1301	0.1073	1.2133	0.226
School Poverty	-0.0847	0.1514	-0.5596	0.576
Total Enrollment	0	0.0001	0.5683	0.570
Urban	0.0523	0.1048	0.4992	0.618
Rural	0.1222	0.1072	1.1401	0.255
Elementary School	0.0027	0.0866	0.031	0.975
R_SQUARE VALUE =	0.0077			

SRI (2002) Instructional Use Scale

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB> |T|
Intercept	2.3114	0.2214	10.442	0.000
E-Rate School	0.1266	0.1795	0.7049	0.481
School Poverty	0.279	0.2282	1.2225	0.222
Total Enrollment	-0.0003	0.0001	-2.4204	0.016
Urban	0.0079	0.1423	0.0558	0.956
Rural	-0.0326	0.1379	-0.2363	0.813
Elementary School	0.3923	0.1421	2.7599	0.006
R_SQUARE VALUE =	0.0781			

SRI (2002) Complex Use Scale

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB> |T|
Intercept	2.4453	0.1913	12.7835	0.000
E-Rate School	0.2219	0.1543	1.4382	0.151
School Poverty	0.0434	0.2099	0.207	0.836
Total Enrollment	-0.0002	0.0001	-1.9503	0.052
Urban	0.0969	0.1276	0.7598	0.448
Rural	-0.0494	0.1375	-0.3594	0.720
Elementary School	-0.2107	0.1258	-1.6744	0.095
R_SQUARE VALUE =	0.0128			

SRI (2002) Professional Use Scale

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB> |T|
Intercept	3.2115	0.211	15.2169	0.000
E-Rate School	0.0157	0.1403	0.1122	0.911
School Poverty	-0.5574	0.2475	-2.2518	0.025
Total Enrollment	-0.0001	0.0001	-1.1928	0.234
Urban	-0.076	0.1181	-0.643	0.521
Rural	0.0071	0.1526	0.0468	0.963
Elementary School	-0.6602	0.1491	-4.4282	0.000
R_SQUARE VALUE =	0.1152			

Most students have basic skills with the Internet

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	1.055	0.0607	17.3844	0.000
School Poverty	-0.3389	0.0835	-4.0573	0.000
Total Enrollment	0	0	-0.4942	0.622
Urban	-0.088	0.0556	-1.5832	0.114
Rural	-0.0368	0.0626	-0.5871	0.557
Elementary School	-0.4179	0.0422	-9.9036	0.000
R_SQUARE VALUE =	0.2712			

Have access to school computer network from home

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.8114	0.09	9.0198	0.000
School Poverty	-0.2584	0.0912	-2.8331	0.005
Total Enrollment	-0.0001	0.0001	-1.131	0.259
Urban	0.0594	0.0545	1.0905	0.276
Rural	-0.1107	0.0689	-1.6069	0.109
Elementary School	-0.0593	0.062	-0.9564	0.339
R_SQUARE VALUE =	0.0291			

Have access to Internet from home through school network

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6828	0.0792	8.6243	0.000
School Poverty	-0.1631	0.0867	-1.8815	0.061
Total Enrollment	0	0	-0.8885	0.375
Urban	0.0558	0.0573	0.9739	0.331
Rural	-0.1434	0.0683	-2.1	0.036
Elementary School	-0.0094	0.0513	-0.1834	0.855
R_SQUARE VALUE =	0.0256			

Have access to telephone in school

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.8796	0.0565	15.557	0.000
School Poverty	-0.0363	0.0723	-0.5025	0.616
Total Enrollment	0	0	0.9383	0.349
Urban	-0.0896	0.0448	-1.9994	0.046
Rural	-0.0677	0.0445	-1.5234	0.129
Elementary School	-0.0363	0.04	-0.9078	0.365
R_SQUARE VALUE =	0.0192			

Have access to E-mail account at school

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	1.0889	0.0583	18.6781	0.000
School Poverty	-0.0689	0.0772	-0.8924	0.373
Total Enrollment	-0.0001	0	-3.3581	0.001
Urban	-0.0565	0.0437	-1.2944	0.196
Rural	-0.1548	0.0594	-2.6048	0.010
Elementary School	-0.1774	0.0466	-3.8036	0.000
R_SQUARE VALUE =	0.0564			

There's a technology coordinator at school

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.8805	0.0655	13.4338	0.000
School Poverty	-0.0324	0.0743	-0.4363	0.663
Total Enrollment	0	0	0.37	0.712
Urban	0.0136	0.052	0.2622	0.793
Rural	-0.0461	0.0636	-0.7249	0.469
Elementary School	-0.0976	0.0444	-2.1986	0.029
R_SQUARE VALUE =	0.0216			

Teacher Regressions: E-Rate Schools

Barrier to use of educational technology: student's can't access web sites during school day

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB> |T|
Intercept	0.3236	0.0881	3.674	0.000
School Poverty	0.3129	0.0915	3.4207	0.001
Total Enrollment	0	0.0001	0.7783	0.437
Urban	-0.0448	0.0564	-0.7953	0.427
Rural	0.0405	0.068	0.5956	0.552
Elementary School	0.0311	0.0636	0.4894	0.625
R_SQUARE VALUE =	0.0243			

Barrier to use of educational technology: Internet connection isn't fast enough for use while teaching

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB> |T|
Intercept	0.6288	0.0864	7.2785	0.000
School Poverty	0.0691	0.1033	0.6692	0.504
Total Enrollment	0	0	-0.3521	0.725
Urban	-0.0549	0.0624	-0.8794	0.380
Rural	-0.0652	0.0686	-0.9497	0.343
Elementary School	0.0033	0.0599	0.0557	0.956
R_SQUARE VALUE =	0.0037			

Barrier to use of educational technology: Internet connection isn't reliable enough for use while teaching

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB> |T|
Intercept	0.5037	0.1052	4.7874	0.000
School Poverty	-0.0115	0.0993	-0.1156	0.908
Total Enrollment	0.0001	0.0001	1.1434	0.254
Urban	-0.0496	0.062	-0.8004	0.424
Rural	0.0009	0.0688	0.0127	0.990
Elementary School	0.0857	0.0659	1.3005	0.194
R_SQUARE VALUE =	0.009			

Barrier to use of educational technology: inadequate technical support

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB> |T|
Intercept	0.644	0.1221	5.2766	0.000
School Poverty	0.0252	0.0918	0.2747	0.784
Total Enrollment	0	0.0001	0.5867	0.558
Urban	-0.022	0.0523	-0.4197	0.675
Rural	0.039	0.0664	0.5869	0.558
Elementary School	0.1205	0.0755	1.5949	0.112
R_SQUARE VALUE =	0.0164			

Barrier to use of educational technology: lack of support from administrators

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB> |T|
Intercept	0.3243	0.0868	3.7361	0.000
School Poverty	0.0685	0.0942	0.7269	0.468
Total Enrollment	0.0001	0.0001	1.6013	0.110
Urban	-0.0367	0.056	-0.6552	0.513
Rural	0.0681	0.0622	1.0942	0.275
Elementary School	0.0959	0.0615	1.5576	0.120
R_SQUARE VALUE =	0.0121			

Barrier to use of educational technology: inadequate training opportunities

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB> |T|
Intercept	0.6139	0.1267	4.8459	0.000
School Poverty	-0.0248	0.1084	-0.2289	0.819
Total Enrollment	0	0.0001	0.3739	0.709
Urban	0.0267	0.0594	0.4491	0.654
Rural	0.0954	0.0743	1.2839	0.200
Elementary School	0.0701	0.081	0.8653	0.387
R_SQUARE VALUE =	0.0087			

Teacher Regressions: E-Rate Schools

Barrier to use of educational technology: Students don't have need technology skills

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.393	0.0889	4.4187	0.000
School Poverty	0.3438	0.0943	3.647	0.000
Total Enrollment	0	0	1.0042	0.316
Urban	0.0891	0.0493	1.8068	0.072
Rural	0.1458	0.0598	2.4403	0.015
Elementary School	0.1136	0.0454	2.4991	0.013
R_SQUARE VALUE =	0.0725			

I consider myself well prepared to use computers and the Internet for instruction

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.6011	0.0978	6.147	0.000
School Poverty	-0.1347	0.0941	-1.4312	0.153
Total Enrollment	-0.0001	0.0001	-1.1349	0.257
Urban	0.0231	0.0573	0.4033	0.687
Rural	0.0137	0.0643	0.2131	0.831
Elementary School	-0.1702	0.063	-2.7023	0.007
R_SQUARE VALUE =	0.0337			

My skill with Internet browsers is at the "transformation" level.

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.3816	0.0889	4.2947	0.000
School Poverty	-0.1968	0.0747	-2.6355	0.009
Total Enrollment	-0.0001	0.0001	-1.2852	0.200
Urban	0.0065	0.0395	0.1635	0.870
Rural	-0.0343	0.0511	-0.6712	0.503
Elementary School	-0.104	0.0582	-1.788	0.075
R_SQUARE VALUE =	0.0333			

My skill with e-mail programs is at the "transformation" level.

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.3652	0.0882	4.1395	0.000
School Poverty	-0.1369	0.0753	-1.8178	0.070
Total Enrollment	-0.0001	0	-2.1104	0.036
Urban	-0.0041	0.0476	-0.0868	0.931
Rural	0.0379	0.0572	0.6627	0.508
Elementary School	-0.0631	0.0584	-1.0795	0.281
R_SQUARE VALUE =	0.0343			

My skill with Web page creation programs is at the "transformation" level.

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.0666	0.0291	2.2891	0.023
School Poverty	-0.0209	0.023	-0.9093	0.364
Total Enrollment	0	0	-0.5585	0.577
Urban	-0.0178	0.0133	-1.3421	0.180
Rural	-0.0205	0.0197	-1.0385	0.300
Elementary School	-0.0257	0.0168	-1.5303	0.127
R_SQUARE VALUE =	0.0104			

SRI (2002) Computer Availability Scale

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	0.3054	0.0774	3.948	0.000
School Poverty	0.1036	0.102	1.0163	0.310
Total Enrollment	0	0	-0.9747	0.330
Urban	-0.0373	0.0665	-0.5615	0.575
Rural	-0.1234	0.0632	-1.9516	0.052
Elementary School	0.0058	0.0553	0.1052	0.916
R_SQUARE VALUE =	0.0159			

Teacher Regressions: E-Rate Schools

SRI (2002) Instructional Use Scale

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	2.4221	0.1955	12.3883	0.000
School Poverty	0.3285	0.2367	1.3877	0.166
Total Enrollment	-0.0003	0.0001	-2.3026	0.022
Urban	0.0381	0.1487	0.2562	0.798
Rural	-0.0143	0.1433	-0.0998	0.921
Elementary School	0.3693	0.1487	2.4827	0.014
R_SQUARE VALUE =	0.0734			

SRI (2002) Complex Use Scale

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	2.6513	0.1817	14.5928	0.000
School Poverty	0.062	0.2218	0.2796	0.780
Total Enrollment	-0.0002	0.0001	-1.7749	0.077
Urban	0.1109	0.1339	0.8278	0.408
Rural	-0.0331	0.1472	-0.2246	0.822
Elementary School	-0.2173	0.1337	-1.6251	0.105
R_SQUARE VALUE =	0.0101			

SRI (2002) Professional Use Scale

PARAMETER	PARAMETER ESTIMATE	STANDARD ERROR OF ESTIMATE	TEST FOR H0: PARAMETER=0	PROB>|T|
Intercept	3.277	0.2264	14.4726	0.000
School Poverty	-0.5656	0.2663	-2.1237	0.034
Total Enrollment	-0.0001	0.0001	-1.141	0.255
Urban	-0.1306	0.1238	-1.0548	0.292
Rural	-0.0492	0.165	-0.2979	0.766
Elementary School	-0.6744	0.1597	-4.2227	0.000
R_SQUARE VALUE =	0.1191			

Appendix D: Bureau of Indian Affairs Empowerment Zone Schools

This appendix provides results of separate analyses of the E-Rate in schools sponsored by the Bureau of Indian Affairs (BIA) and schools located in federally designated Empowerment Zones (EZs).

Bureau of Indian Affairs Schools

The analysis of BIA schools was conducted using E-Rate administrative data through January 2000, obtained from the Schools and Libraries Division (SLD). The data were merged with school- and district-level information from the 1998–99 NCES Common Core of Data (CCD) and information obtained directly from the Bureau of Indian Affairs.[40] Using these data, the following were the key results from an analysis of E-Rate application and funding patterns:

- **Most non-BIA schools serving American Indians applied for the E-Rate program.** The application rates vary from a high of over 80 percent for schools with up to 2 percent American Indian enrollment to a low of about 60 percent for schools with 50 to 80 percent American Indians. Schools with no American Indian students had application rates around 75 percent.
- **Application rates are related to school size:** While application rates generally increase with the size of the school, the participation rates of non-BIA schools with over 80 percent American Indian enrollment were not as clearly related to school size.
- **BIA schools greatly increased their E-Rate use between Years 1 and 2.** The application rate of BIA schools was very low in the first year of the E-Rate program (35 percent); by the second year, the BIA schools had the highest application rate of any group of schools analyzed (over 95 percent) and received more than three times the national average in per student funding commitments. Total commitments to BIA schools rose by a factor of 20, from only $300,000 in Year 1 to over $6 million in Year 2.
- **All BIA applicants were funded.** All BIA schools that applied for the E-Rate received at least some funding in both years of the program, in comparison with about 98 percent of all schools that applied for E-Rate discounts.
- **BIA schools had high application rates compared with similar schools in Year 2.** BIA application rates for the E-Rate program are higher than other schools with similar levels of poverty and urban location, which are the factors that determine the E-Rate

[40] BIA provided data on free and reduced-price lunch participation, and the 1998–99 CCD data contained information on rural location. Both sources had total enrollment. The original data identified some BIA schools as being under the jurisdiction of the BIA in Washington, D.C. These were removed before adding in the new data to avoid double counting.

discounts. The BIA schools also had much higher application rates than other schools with 100 percent American Indian enrollment.

Empowerment Zones

The Empowerment Zone program, started in 1994, seeks economic growth in low-income communities through a combination of loans, grants, tax breaks, and community partnership initiatives.

This analysis examined whether applications for E-Rate discounts were higher for schools in EZ areas, again using E-Rate administrative data obtained from the SLD for the period ending January 2000. EZ schools were identified by the U.S. Department of Education using a list of schools that serve youth in EZ communities.

The key finding from this analysis is that schools in EZ communities generally apply for the E-Rate program at a higher rate than schools in other communities that are similar in terms of poverty and geographic location (the criteria that determine E-Rate funding eligibility). This finding suggests that the Empowerment Zone program may be helping communities take advantage of important opportunities for economic development, including those with long-term payoffs, such as the E-Rate program.

Appendix E: Comparison of Characteristics of E-Rate and Non-E-Rate Districts and Schools

As shown in exhibit E-1, non-E-Rate districts are less poor, smaller, less likely to be located in an urban area, and less likely to receive Technology Literacy Challenge Fund (TLCF) grants than are E-Rate districts. Similarly, non-E-Rate schools are less poor and less likely to be located in an urban area than E-Rate schools, but they are larger. Because of these underlying differences in important background characteristics, multivariate regression (weighted) was used for the analyses discussed in this report to control for factors that may be related to the outcomes of interest.

Exhibit E-1: Comparison of E-Rate and Non-E-Rate Districts and Schools: Student-weighted Population Estimates[41]

	Districts		**Schools**	
Characteristic	E-Rate	Non-E-Rate	E-Rate	Non-E-Rate
Poverty Concentration				
Lowest third	32.3%	60.3%	31.8%	48.9%
Middle third	33.5%	27.1%	34.8%	20.7%
Highest third	34.5%	12.6%	33.5%	32.5%
Enrollment Size				
Lowest third	32.5%	54.4%	33.5%	29.1%
Middle third	33.0%	38.4%	33.4%	30.4%
Highest third	34.4%	7.3%	33.1%	40.6%
Location				
Urban	33.9%	11.0%	36.5%	23.1%
Suburban	31.7%	49.9%	36.1%	52.3%
Rural	34.5%	39.1%	27.5%	24.6%
TLCF Recipient				
Yes	51.2%	25.8%	N/A	N/A
No	48.7%	74.2%		
Totals				
Percentage of all students	96.3%	3.8%	90.4%	9.6%
Raw sample (N)	676	88	716	140

TLCF=Technology Literacy Challenge Fund

[41] Poverty concentration and enrollment size distributions were broken into thirds using the overall population-weighted data. Because the distributions are based on the full sample of districts and schools, and because E-Rate participants make up most of the overall sample, E-Rate participants are also roughly split into thirds by poverty and size.

Appendix F: A "Natural Experiment" to Assess the Effect of E-Rate Discounts

As discussed in chapter III, the analyses for this study included the estimation of regressions using the discount rate of applicants as a sort of "natural experiment," controlling for their poverty and rural status. More precisely, the change in the reported level of existing Internet and telecommunications services between 1998–99 and 1999–00 was regressed on the district's poverty rate, rural location, and E-Rate discount rate in 1998. These analyses found no evidence of any positive effects of the discount rate on changes in the reported level of services (exhibit F-1). In addition, when the discount rate was dropped from the equation, there was still no evidence of an effect of poverty on the change in the level of Internet and telecommunications services, except for the fraction of classrooms connected, where it is positive and statistically significant (exhibit F-1). This finding suggests that the E-Rate discounts had not had a statistically significant effect on the reported level of services, at least for the selected sample of districts (i.e., those that applied for the same set of schools in both years) by the time these districts applied for the second wave of funding (1999–00). Again, it should be emphasized that funding delays are a likely explanation for this finding.

Another explanation for the lack of statistically significant results might be that the data were not well matched. However, the discount rate was found to be strongly associated with estimated dollars received by schools,[42] even after controlling for poverty and urban location (exhibit F-2).[43]

[42] Some E-Rate discounts are shared across schools; other discounts are school-specific. In this regression it was assumed that the shared dollars were distributed evenly per student across schools.

[43] For districts, the discount rate is the student-weighted average of the discount rates for the individual schools on their application.

Exhibit F-1: "Natural Experiment": Estimated Effects on Changes in Existing Services, Controlling for District Characteristics

Type of Service	Independent Variable	Model with Discount Rate, Estimate (Standard Error)	Model without Discount Rate, Estimate (Standard Error)
Phones per student (N=3,242)	High discount rate	0.001 (.001)	
	Poverty	-0.002 (.0015)	-0.001 (.0015)
	Rural	-0.0003 (.0009)	0.000 (.0007)
Internet computers per student (N=2,613)	High discount rate	-0.001 (.005)	
	Poverty	0.009 (.008)	0.004 (.0075)
	Rural	0.017 (.005)***	0.017 (.0038)***
Conferencing links per student (N=625)	High discount rate	0.0001 (.0006)	
	Poverty	0.0005 (.0009)	0.043 (.0358)
	Rural	-0.0005 (.0006)	-0.0004 (.0004)
Fraction of buildings connected to Internet (N=697)	High discount rate	-0.044 (.022)**	
	Poverty	0.072 (.038)*	0.043 (.036)
	Rural	0.055 (.022)**	0.040 (.019)**
Fraction of rooms connected to Internet (N=1,231)	High discount rate	0.014 (.022)	
	Poverty	0.057 (.036)	0.069 (.034)**
	Rural	0.033 (.021)	0.042 (.018)**
Internet connections per student (N=2,549)	High discount rate	-0.002 (.002)	
	Poverty	0.003 (.003)	0.001 (.003)
	Rural	0.002 (.002)	0.001 (.002)
Maximum speed of Internet connections (Mb; N=2,081)	High discount rate	-2.629 (2.025)	
	Poverty	-1.722 (3.374)	-3.217 (3.223)
	Rural	3.605 (1.981)*	2.144 (1.605)

Notes: All regressions run with intercepts. "High discount rate" means that the rate is above average given the applicant's poverty status. Poverty is the percentage of students eligible for free or reduced-price meals as reported on the E-Rate application. Unit of observation is the applicant; only includes those that applied for same schools in two years.
*=p<0.10, **=p<0.05, ***=p<0.01

Source: E-Rate administrative data, January 2000, merged with National Center for Education Statistics, Common Core of Data

Exhibit F-2: "Natural Experiment": Estimated Effects on Average Discount Levels, Controlling for District Characteristics

Outcome	Independent Variable	Model with Discount Rate Estimate (Standard Error)
E-Rate discount ($) per student (N=132,494)	High discount rate	0.001 (.0004)*
	Poverty	0.006 (.0007)**
	Rural	-0.001 (.0004)*

Note: Regressions run with intercepts. "High discount rate" means that the rate is above average given the applicant's poverty status. Poverty is the percentage of students eligible for free or reduced-price meals as reported on the E-Rate application. Unit of observation is the school.
*=p<0.05, **=p<0.01

Source: E-Rate administrative data, January 2000, merged with National Center for Education Statistics, Common Core of Data

In addition, at the district applicant level, high-poverty districts report planning much larger increases in services than less poor districts (exhibit F-3). The association between the discount rate and planned services is generally less clear, although it is positive for phones and conferencing links per student.[44]

A final explanation for the failure to find statistically significant results is that the analysis was based on a relatively small subset of districts that had applied for the same set of schools in the first two years of the program. Indeed, the sample sizes in exhibit F-1 are much smaller than those in exhibit F-3, which includes all applicants that applied for the relevant service, not just those that applied for the same sets of school in both years. However, it should also be noted that the standard errors reported in exhibit F-1 are still quite small. Indeed, they are generally much smaller than the differences in the levels of services reported in exhibit 2 in chapter III. Thus, at the very least, we cannot conclude from this analysis that the E-Rate discounts contributed to the reported changes in access to the Internet and other telecommunications services.

[44] This last set of regressions is based on the largest application for all applicants that applied in both years of the program for any schools, even if the set of schools changed. When we limit it to applicants for whom the schools did not change, the results are less clear, probably because the samples are smaller.

Exhibit F-3: “Natural Experiment”: Estimated Effects on Planned Services, Controlling for Existing Services and Other District Characteristics.

Type of Service	Independent Variable	Model with Discount Rate Estimate (Standard Error)
Phones per student (N=13,212)	High discount rate	0.001 (.0004)**
	Poverty	0.006 (.0007)***
	Rural	-0.001 (.0004)**
	Existing services	1.048 (.0045)***
Internet computers per student (N=10,911)	High discount rate	-0.0004 (.0022)
	Poverty	0.057 (.0036)***
	Rural	0.008 (.0022)***
	Existing services	0.909 (.0068)***
Conferencing links per student (N=3,742)	High discount rate	0.0030 (.0005)***
	Poverty	0.0046 (.0009)***
	Rural	-0.004 (.0005)***
	Existing services	0.940 (.0346)***
Fraction of buildings connected to Internet (N=1,486)	High discount rate	-0.0041 (.0128)
	Poverty	0.1004 (.0224)***
	Rural	-0.0118 (.0126)
	Existing services	0.505 (.0184)***
Fraction of rooms connected to Internet (N=2,849)	High discount rate	0.0183 (.0125)
	Poverty	0.1364 (.0199)***
	Rural	0.0171 (.0123)
	Existing services	0.588 (.0141)***
Internet connections per student (N=11,075)	High discount rate	0.0009 (.0009)
	Poverty	0.0062 (.0001)***
	Rural	-0.002 (.0009)**
	Existing services	1.132 (.0070)***
Maximum speed of Internet connections (N=9,826)	High discount rate	-2.003 (1.0518)*
	Poverty	20.336 (1.7237)***
	Rural	3.491 (1.052)***
	Existing services	0.821 (.0098)***

Note: All regressions run with intercepts. “High discount rate” means that the rate is above average given the applicant’s poverty status. Poverty is the percentage of students eligible for free or reduced-price meals as reported on the E-Rate application. Unit of observation is the applicant.
*=p<0.10, **=p<0.05, ***=p<0.01

Source: E-Rate administrative data, January 2000, merged with National Center for Education Statistics, Common Core of Data

While these data were not designed to estimate the impact of the E-Rate program, they may provide useful information, especially if most school districts continue to apply for the program in future years. Repeating these analyses with a greater number of observations—

and with the benefit of a longitudinal dataset—may be a valuable avenue for future research. Of course, these data are limited by the fact that school districts may apply on behalf of different schools, making the estimates not representative of all districts. Nevertheless, this method could provide compelling evidence for the subset of districts that do apply for the same set of schools over time.