Gains and Gaps in Education Technology

An NEA Survey of Educational Technologies in U.S. Schools

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The National Education Association is the nation's largest professional employee organization, representing 2.7 million elementary and secondary teachers, higher education faculty, education support professionals, school administrators, retired educators, and students preparing to become teachers.

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Preface

This study sought to compile a set of national data on educational technology in the classroom from the perspectives of teachers and education support professionals (ESPs; "classified employees"). It aims to provide the NEA's state and local affiliates with national data against which they can gauge their own progress in using computer-based and multimedia technologies. Also, because access to technologies in public schools is expanding, the report can be of long-term use as a benchmark for progress in educational technology, particularly across jurisdictions, and for monitoring the disparities between demographic groups of public school staff in their access to and application of technology.

The NEA Technology Issues Survey collected the data used in this report in 1998 and 2001. These are the most recent in-depth data available at the national level on teachers' perspectives. In all, 3,371 NEA members participated in the initial survey; the findings here represent only the 1,001 members who participated in both surveys. (Appendix A discusses the differences in the two sample populations.) Plans are currently under way to update the survey instrument and collect national data again. It is anticipated, beyond that effort, that the NEA will monitor the implementation of technology in public schools on regular intervals and will conduct subsequent studies.

NEA Research designed this study to collect information on access to and use of technology in our nation's public schools and classrooms. The OPSCAN Surveys Program—a technical service NEA Research provides to state and local affiliates of NEA—administered the survey. The comprehensive survey instrument examined the availability and capacity of technology hardware, types of applications, and levels of connectivity. The survey also explored the effectiveness of technology in improving the job performance of school staff. (Appendix B to this report is a complete copy of the instrument.)

The results of the study appear in this report for the overall sample of respondents and for selected demographic groupings. Tables of cross-tabulations for all survey items with the demographic subgroups appear under separate cover.

NEA Research thanks the NEA members who took the time to respond to this survey in 1998 and particularly those who so willingly participated again in 2001. Their candid responses to the survey and their commitment to our nation's children made our work on the project so much easier and very fulfilling. Sincere thanks also go to Barbara Stein, our resident NEA expert on educational technology, whose feedback and ongoing work in this area helped us see the "big picture" much more clearly. And, ever so many thanks to Chuck Williams for recognizing the value of this project and for helping us keep it on track for publication despite the many competing priorities. Finally, much gratitude goes to Joanne Walters for assisting with the numerous details of this project from its inception to the very end; to Paul Wolman for his skills in turning research language into a "real" story; and to Catherine Rawson for desktopping and design work.

Kathy Tuck of NEA Research prepared this report. For questions, please call (202) 822-7400.

Executive Summary

Education technology is a critical component of twenty-first century teaching and learning, and the National Education Association (NEA) is monitoring it closely. This report presents data derived from studies of technology issues conducted among members of the NEA, including classroom teachers, education support professionals (ESPs), administrators, and instructional specialists.[1] Like other studies, this one finds continuing progress in accessibility and usage of technology in public schools. However, by including the experiences of individual educators instead of studying schoolwide snapshots, as do other national studies, these data reveal a unique, more focused picture of both gains and gaps in the technologies inside public school classrooms across America. [2]

The study findings reveal that almost all educators now have access to a computer in and out of school and that they are making valiant attempts to use education technology as an instructional tool. Educators who responded to the surveys acknowledged seeing improvements in their job performance through their use of computers. Yet, closer examinations reveal that their access to education technology has been plagued with numerous problems, such as too few computers and Internet connections inside classrooms for students' use, old or obsolete equipment, lack of technical support, and lack of staff training on integrating technology into instruction. Also, the findings reveal that educators' perceptions of technology have changed over time in both positive and negative ways. Of particular note are the disparities in educators' access to, training in, and use of technology based on their demographic characteristics, such as career stage and school level, the region in which they work, and the income of their students' families.

Major Findings

The results of the studies show improvements in certain areas of education technology but continuing challenges in others:

- *Most public school educators had access to a computer in their school building and classroom, but students' access inside the classroom remained inadequate.* The majority of educators could access just one or two computers in their classrooms or primary work areas,[3] and only a few had more than five computers for their students' use.

- *Educators were involved in their schools' decisions about technology purchases but remained convinced that upgrades and technical support were inadequate.* Most educators reported that they considered software available to teachers and students adequate, but nearly half said that old or obsolete equipment was still an obstacle. Nearly half also indicated that the lack of technical support (i.e., troubleshooting and upgrades) they received for maintaining the existing equipment was an obstacle. There was only a slight improvement in providing technical support for existing equipment during the period under study.

- *Public school educators became more familiar with using education technology, but their training has not adequately prepared them to use technology for instruction.* There was substantial progress in using technology for word

[1] The term *ESP*, as the NEA uses it, comprises workers in the following nine job groups: Custodial, Security, Food, Health/Student, Paraeducator, Clerical, Technical, Trades, and Transportation.

[2] This study included NEA members only, but for convenience, and because the NEA represents most public school educators, NEA members are referred to as public school educators.

[3] In this document, the phrase "in the classroom or primary work area" is typically shortened to "in the classroom" for convenience. Note that a primary work area *does* include libraries and media areas but *does not* include school computer labs, which many classes typically share as a secondary work area.

processing of class materials and for e-mail, particularly in communicating with parents. Educators also improved in using the Internet to obtain new information. However, educators were less confident about their training on integrating technology into their instruction, and most considered the lack of time to learn about new technology as an obstacle to their job effectiveness.

- *Training on using technology was not adequate to prepare most instructional staff (i.e., classroom teachers and paraeducators) to use technology for instruction.* Educators increased their use of technology for sharing information with colleagues, but few educators found opportunities to engage their students in distance learning or to integrate technology into other instructional activities. Of the few who attempted to integrate technology into instruction, some used it to vary instructional delivery; these educators were more likely to be working in secondary or low-poverty schools. Others used technology to reinforce student skills through drill and practice; these educators were more likely to be working in elementary or high-poverty schools.
- *Substantial gaps in technology access remained for particular demographic and geographic groups.* The numbers of computers available in high-poverty and low-poverty classrooms were nearly equal, but computers in high-poverty schools were older and more obsolete and had less adequate software. Educators were less likely to have Internet access if they worked in high-poverty schools or in elementary schools, if they were newer in the profession, or if they resided in the eastern part of the country.
- *Some educator attitudes on technology issues remained the same over time, but others changed significantly or became more complex.* Among the comparatively stable attitudes were the strong associations teachers made between technology and use of e-mail and the Internet, as well as the belief that technology would help them work with greater numbers of students. In contrast, an attitude that evolved dramatically during this period was the value that teachers placed on technology as a tool for direct, individualized instruction. Initially, educators who valued technology most used it for word processing of class materials and in more routinized forms of learning, such as student drills. Later, educators who valued technology most used it to tailor instruction to individual student needs. These latter educators also felt that technology had helped their students attain achievement goals and standards. That association—between technology and student achievement—was not apparent in educators' initial reports.

Recommendations

The recommendations proposed here are grounded in these findings, and they expand on recommendations proposed by the NEA more than a decade ago under the auspices of the Special Committee on Telecommunications (NEA 1992). These recommendations call for action and policy changes on technology at all levels of the public education system:

- ***Computers should be made available in classrooms at a ratio that allows students to gain regular, unencumbered access throughout the school day.*** Educational policy makers and school administrators should continue exploring avenues to bring more computers into public school classrooms, and they should seek to better understand how the investment in more classroom computers could strengthen teaching and learning.
- ***A more integrated and broad-scale approach to providing equipment upgrades and technical support should be devised through staff training and district planning.*** State and district technology plans should ensure adequate and ongoing technical support for school computers and other technology either by training school personnel or by securing the services of outside contractors. Moreover, efforts to tap public and private funding sources should be encouraged to allow schools to purchase, maintain, and upgrade technology.
- ***The inclusion of public school staff in decision-making about school technology should not merely involve decisions about technology purchases but should now also include decisions about training and professional development opportunities.*** Local affiliates and members should become active participants in this decision making through collective bargaining to ensure that educators receive the high-quality training needed to integrate technology into their instruction. Particular attention should be given to educators in high-poverty schools and to those in the western regions of the country (i.e., Midwest, West, and Pacific), because these groups have received less training than their counterparts in the eastern regions.

- ***Schools of education and state departments of education should adopt the National Educational Technology (NET) standards of the International Society for Technology in Education (ISTE), or similar ones, to ensure that all preservice and in-service teachers are adequately prepared to use technology as an integral part of their instruction.*** Also, educators need to recognize that professional development in technology is an ongoing process, one to which they must commit themselves, and they should further understand that the integration of technology into instruction will require fundamental changes in the way teachers and paraeducators do their jobs.
- ***Closing disparities between demographic groups should be a primary focus for increasing access to technology in schools.*** Access to the Internet and other technologies should be made available to educators in their early careers and to educators working in elementary schools to ensure that both new teachers and young students have opportunities to build on skills they may have already acquired outside of school. Moreover, affiliates in the eastern regions of the country need to be made aware of their lagging access to computers and the Internet, and the NEA should provide regional support by pooling resources to help ensure that access to technology becomes equalized throughout the country.
- ***The capacity of computers with Internet access in high-poverty schools should be upgraded and maintained in a manner similar to that of low-poverty schools to close the gap with low-poverty schools.*** The NEA and state affiliates should take full advantage of partnerships forged with other organizations, public agencies, and state governments to ensure that the digital divide continues to close at a steady pace and that other inequities are not created by the type of digital access found in high-poverty schools.
- ***The NEA strongly urges further research and development on effective technology programs to help inform the debate on the "value" of technology in education.*** Federal funding agencies, state education agencies, school districts, and NEA state affiliates need to inspire more research on broad-scale school technology programs—ones that are integrated into instruction and that lead to improved student outcomes. The NEA recommends placing further emphasis on research that explores "best practices" to help document direct links between school technology and student achievement. Research and documentation will pave the way for better planning and implementation of technology in the schools.

1

Introduction

In an ongoing effort to confront and explore educational issues that directly affect schools and classrooms, the NEA conducted a longitudinal survey of members in 1998 and 2001 concerning technology issues they face inside and outside of school. Although other national studies have been conducted on the status of technology in public schools, most are based on general, school- or districtwide data (see chapter 3 for discussion), and little information has been solicited directly from public school teachers and education support professionals.

The results of these NEA surveys of educators themselves provide strong evidence that although much progress has been made, critical and somewhat complex challenges are still present. This report highlights notable gains in technology access and use among public school educators between 1998 and 2001 and discusses the degree of impact that technology has on their job performance. Also, differences among groups of staff are revealed based on particular demographic characteristics.

This report is intended as a guide for NEA affiliates, members, and others interested in gauging the progress of technology in public education, and it raises issues that must be carefully considered as public school educators and students attempt to meet rising educational standards.

Characteristics of Survey Respondents

The survey conducted in 1998 included a randomly selected sample of 3,371 NEA members, and the follow-up survey conducted in 2001 included 1,001 of the original respondents.[4] The findings in the present report represent only the 1,001 members who participated in both surveys, 1998 and 2001.

Professional

The vast majority (84.3%) of the respondents were classroom teachers. Small percentages were instructional specialists such as counselors, librarians, and media or technology specialists (6.7%); education support professionals (ESPs; 6.1%); and administrators (2.9%). Almost all respondents (96.3%) had direct instructional responsibilities for students. In addition to classroom teachers, instructional staff included 72.1 percent of the ESP respondents, 65.6 percent of instructional specialists, and 20.5 percent of the administrators. A plurality of respondents (40.6%) had worked in the field of education for more than 20 years (senior career level), and more than one-fourth (28.4%) had done so for 11 to 20 years (mid-career level). Of those remaining (early career level), 13.7 percent had worked in education for 6 to 10 years, and 1.4 percent had been in the field for 5 or fewer years.

Personal

Slightly more than half (51.0%) of the respondents were between the ages of 46 and 55, and nearly one-fourth (23.0%) were between 36 and 45. The oldest and youngest groups comprised the smallest proportions: 14.8 percent were more than 55 years old, and 9.9 percent were between 26 and 35 years old. More than three-fourths (76.9%) of the respondents were female. The majority (92.5%) classified their race or ethnic group as white, and nearly all (96.1%) indicated that they were not of Hispanic origin. A small proportion indicated their race or ethnic group as black (3.9%). Less than 1 percent each indicated their race or ethnic group as American Indian/Alaskan Native (0.4%) or Asian/Pacific Islander (0.4%). Nearly two-thirds (64.4%) had a mas-

[4] See Appendix A, Limitations of the Study, for a discussion of attrition bias in the follow-up sample.

ter's degree or higher, and only 4.9 percent had less than a bachelor's degree.

School Environment

Slightly more than one-half (52.0%) of the survey respondents worked at the elementary school level; less than one-fifth (17.7%) were assigned to middle or junior high schools; and one-fourth (24.8%) worked primarily in senior high schools. A small percentage (5.1%) also worked at sites with a combination of grade levels. Just under half (45.0%) of the respondents worked in schools classified as "high poverty." The present study classifies a school as "high poverty" if 40 percent or more of its students are eligible for free or reduced-price lunch. This is the same qualifying level for schoolwide compensatory funding under Title I of the Elementary and Secondary Education Act of 2001 (ESEA), also known as the No Child Left Behind Act (NCLB; National Center for Education Statistics [NCES] 2003b).

Study Methodology

A random sample of NEA members, including classroom teachers, ESPs, administrators, and instructional specialists (e.g., counselors, librarians, and media specialists), was selected nationally for participation in the 1998 survey. Members were oversampled according to their geographical region of the country to help ensure that various demographic subgroups would be adequately represented in the analyses of data. In sum, 3,371 members responded to the survey in 1998, representing 2,939 public schools that could be identified across the country. The overall rate of response to the 1998 survey amounted to 84.7 percent of the original sample after the appropriate adjustments.[5] The majority of the survey respondents (79.3%) responded to the survey by mail, and slightly more than one-fifth (20.7%) were interviewed by telephone after multiple appeals by mail were unsuccessful. Membership weighting factors for the regions were computed and appropriately applied. In 2001, about a thousand (1,001) respondents to the 1998 survey, representing as many schools, were contacted by telephone and administered a slightly modified version of the survey (see Appendix B). The data for the 1,001 members participating in both surveys are presented in this report. (*Note:* Margin of error = ± 3%; 95% level of confidence.)

The Common Core of Data (CCD) Public Elementary/Secondary School Universe Survey: School Years 1997–98 and 2000–01 (NCES 1999, 2002a) was used to determine the percentage of students who were eligible for free or reduced-price lunch (i.e., the level of poverty) in the schools represented in each year of the surveys.

[5] Adjustments were made to eliminate members from the sample who were ineligible for participation in the study (i.e., retired or not school-based) and members who were out of reach (i.e., inaccurate address and telephone information).

2

Major Findings

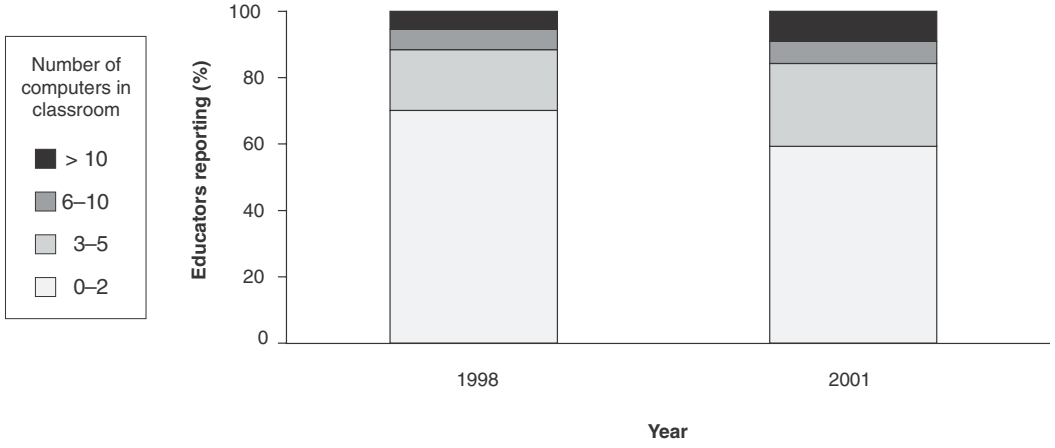
Public school teachers, ESPs, and their students have enjoyed widespread and increasing access to computers and other technology in and out of school. Many challenges remain, however, for achieving adequate and equal access, as well as for providing technical support and training.

Access to Technology

The findings of this study show that by 2001, nearly all public school educators, including teachers and ESPs, had access to a computer at school (98.2%, compared with 97.5% in 1998). Most also had access to a computer at their own or someone else's home (94.6%; a 12% increase since 1998), and nearly all had access at a public facility such as a library or university (97.8%; a 56% increase).

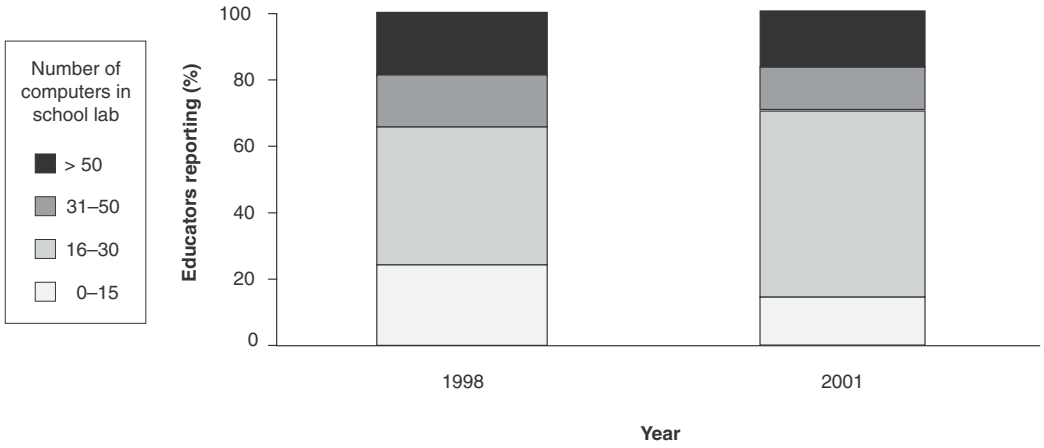
However, rising demands for student achievement require staff and students to have direct and continuous access to educational materials and instructional resources, and the need for computers in classrooms has increased. In 1998, just over half (51.5%) of educators reported that their students' main access to computers at school was in the classroom. This number increased to 60.2 percent in 2001. Yet, in that year, most public school classrooms continued to have no more than two computers available for students' use (Figure 1a).

Figure1a. Number of Computers for Students' Use in Classroom



Number of computers in classroom	Educators reporting (%)	
	1998	2001
> 10	5.4	9.1
6–10	6.1	6.6
3–5	18.4	25.0
0–2	70.1	59.3

Figure 1b. Number of Computers for Students' Use in School Labs



Number of computers in school lab	Educators reporting (%)	
	1998	2001
> 50	18.5	15.8
31–50	16.2	13.9
16–30	40.7	52.9
0–15	24.6	17.4

The average number of computers available to students in school computer labs declined from 32.18 in 1998 to 28.91 in 2001 (standard deviations = 25.01 and 18.51, respectively).[6] In part, this was because many of the larger school labs, those accommodating 31 or more students, were reduced in size between 1998 and 2001, and many smaller labs were eliminated, increased in size, or consolidated (Figure 1b).

Although the number of computers in school labs declined slightly between 1998 and 2001, reliance on computers and other technologies inside the classroom increased substantially. Reliance on the Internet was up in particular—by 37 percent. However, the decline in the number of computers in labs was not matched in magnitude by the increase in computers in the classroom (see Figure 1a). The number of classrooms that provided students with their main access to a television (TV), videocassette recorder (VCR), and cable TV also increased during this period (Table 1).

Table 1. Main Access to Various Types of Technology Is Provided in the Classroom (percentages of educators responding affirmatively)

	Educator responses (%)		
Type of technology	1998	2001	% increase
Computers for student use	51.5	60.2	8.74
Internet, World Wide Web, and e-mail	37.1	74.1	37.06
Television	60.5	71.6	11.12
VCR	55.3	67.9	12.64
Cable TV	37.7	51.8	14.17

[6] Because of the large variance associated with the number of computers in classrooms, a reliable average (mean statistic) cannot be computed. However, the smaller variance associated with the number of computers in school computer labs yields a more reliable average and is therefore reported.

Resources and Technical Support

Slight increases occurred in staff involvement in school technology decisions by 2001, with nearly three-fourths (74.9%) of educators reporting that teachers and ESPs in their schools were involved in decisions to purchase computers and other new technologies (a 2% increase). However, an even larger majority (85.6%) reported that teachers and ESPs were involved in decisions to purchase computer software (a 7% increase). As staff involvement in technology decisions increased, gains in certain resources and support proved substantial, and certain technology obstacles were reduced. Moreover, 13.2 percent of educators reported that their school districts provided them with low- or no-interest loans to purchase computers for home use (Table 2).

Although most educators generally believe technology resources and support in their schools were adequate, a large proportion also reported encountering obstacles. Three-fourths (76.7%) of the educators reported in 2001 that software programs for teachers were adequate, and slightly more (78.8%) said that software programs for students were adequate. However, more than half (55.0%) believe that the lack of funds for computers, software, and other technology posed an obstacle to their effectiveness. More than three-fourths (79.2%) also indicated that the current capacity of computers in their schools was adequate, but nearly one-half (48.7%) stated that old or obsolete computers continued to obstruct their on-the-job effectiveness. Nearly three-fourths (72.2%) of educators said that the maintenance of their school's computer equipment was adequate. A smaller proportion, but still more than two-thirds (67.2%), reported that technical support for using equipment and software in their schools was adequate. However, nearly half (48.7%) indicated that lack of technical support (i.e., troubleshooting and upgrading of existing equipment) was an obstacle (Table 3).

Table 2. Adequacy of Technology Resources and Support (percentages of educators responding "adequate" or "more than adequate")

	Educator responses (%)		
Technology resource	**1998**	**2001**	**% increase**
Software programs for teachers (e.g., word processing, graphics, programs to calculate grades)	63.9	76.7	12.74
Software programs for students (e.g., word processing, graphics, remedial packages, individualized instruction, games)	63.1	78.8	15.66
Capacity of school computers	66.4	79.2	12.85
Maintenance of existing equipment	62.0	72.2	11.24
Technical support for using equipment and software	54.9	67.2	12.33
District provides low- or no-interest loans to teachers to purchase computers	13.7	13.2	–0.48

Table 3. Obstacles to Using Technology (percentages of educators responding "somewhat" or "very much" an obstacle)

	Educator responses (%)		
Technology resource	**1998**	**2001**	**% decline**
Old or obsolete equipment	55.2	48.7	– 6.54
Lack of tech. support to maintain existing equipment	50.7	48.7	–1.96
Lack of access to computers, software, and technology	44.2	31.5	–12.68
Lack of funds for computers, software, and technology	62.9	55.0	–7.87

Table 4. Adequacies and Obstacles in Technology Training (percentages of educators responding "somewhat" or "very much")

	Educator responses (%)		
Training issue	1998	2001	% change
Training on existing equipment and software is adequate	53.5	71.7	18.27
Training on accessing online services is adequate	46.7	69.2	22.49
Training on integrating tech. into instruction is adequate	40.3	59.5	19.21
Unfamiliarity with computers, lack of training are obstacles	50.9	42.1	–8.85
Lack of time to learn new technology is an obstacle	82.8	79.3	–3.51

Note: Adequate includes responses of "somewhat" or "more than" adequate. *Obstacle* includes responses of "somewhat" or "very much" an obstacle.

Technology Training and Professional Development

Substantial gains took place in training staff on using education technology, but fewer opportunities to learn about instructional uses occurred. Nearly three-fourths (71.7%) of educators reported that training on existing equipment and software was adequate, and two-thirds (69.2%) reported that training on accessing online services was adequate (a 23% increase). However, substantially fewer educators (59.5%) reported that their training on integrating technology into instruction was adequate. Slightly less than half (42.1%) stated that unfamiliarity with computers or a lack of computer training impeded their on-the-job effectiveness (Table 4). In addition, more than three-fourths (79.3%) of educators said that lack of time to learn about new technology was an obstacle.

Use and Impact of Technology on Job Effectiveness

Educators who instruct students (classroom teachers and paraeducators) still used technology mostly for word processing rather than for direct instruction. Nearly three-fourths (74.2%) of the instructional staff used word processing software, compared with less than one-half (45.6%) in 1998 (a 29% increase). But fewer than half (46.5%) used CD-ROMs for instruction, even fewer (25.7%) used multimedia software, and most had not engaged any of their students in online collaborative teaching or distance learning (Table 5).

Use of the Internet by instructional staff increased substantially between 1998 and 2001, with 43.4 percent "surfing" the Web from school one or more hours a week (a 36% increase), and nearly two-thirds (61.5%) using the Web outside of school (a 54% increase). The use of e-mail and other messaging also increased substantially. More than half (53.1%) of the instructional staff regularly sent and read e-mail from school (a 32% increase). Nearly one-third (31.3%) regularly used technology at school to share teaching ideas with other teachers (a 26% increase). One-third (33.4%; a 20% increase) exchanged instructional information with another teacher at another school via computers. Substantial gains were also made since 1998 in staff using technology to communicate with parents. One-half (50.6%) of the instructional staff communicated with par-

Table 5. Type of Technology Used at School and Outside of School (percentages of educators responding affirmatively)

	Educator responses (%)		
Type of technology	1998	2001	% increase
Word processing software for instruction	45.6	74.2	28.60
CD-ROMS for instruction	35.1	46.5	11.39
Hypermedia/multimedia software for instruction	17.1	25.7	8.65
Laser disks or videodisks for instruction	7.8	6.4	1.42

Table 6. Used the Internet and E-mail (percentages of educators responding affirmatively)

Use of technology	Educator responses (%) 1998	2001	% gain
Surf the Web at school	7.4	43.4	36.06
Surf the Web outside of school	7.7	61.5	53.81
Send/read e-mail at school	20.7	53.1	32.39
Send/read e-mail outside of school	16.1	54.7	38.67
Communicate with parents by e-mail	11.8	50.6	38.80
Use computer technology to share			
Teaching ideas with other teachers at school	5.3	31.3	26.02
Teaching ideas with other teachers outside of school	5.3	16.6	11.35
Instructional information with a teacher at another school	13.2	33.4	20.19
Engage students in online teaching or distance learning	3.2	5.7	2.50
School has a home page on the Web	45.4	78.3	32.88

ents by e-mail (a 39% increase), and three-fourths (78.3%) of all educators reported that their schools had a home page on the Web for public access (a 33% increase). However, most had not engaged any of their students in online collaborative teaching or distance learning (Table 6).

Most educators who instructed students also reported that technology had helped to improve their effectiveness in their job. The majority (87.4%) reported that technology had improved their word processing of tests, handouts, and other written materials, and the majority (80.8%) further reported that technology had helped them to improve their access to new information (a 32% increase). To a lesser extent, educational technology affected the teaching strategies of instructional staff. Nearly three-fourths (71.5%) reported that technology helped them improve in individualizing instruction; 69.4 percent cited improvements in varying instructional delivery; and 69.1 percent cited improvements in reinforcing student skills through drill and practice. Slightly more than half (53.7%) also reported improvements in working with more students. In all, some three-fourths (76.3%) of the teachers and paraeducators asserted that technology had improved their ability to help students attain achievement goals (a 25% increase; Table 7).

Demographic Influences on Education Technology

This study sought to determine the extent that particular technology issues differed in their implementation and impact for the demographic groups. This report focuses on

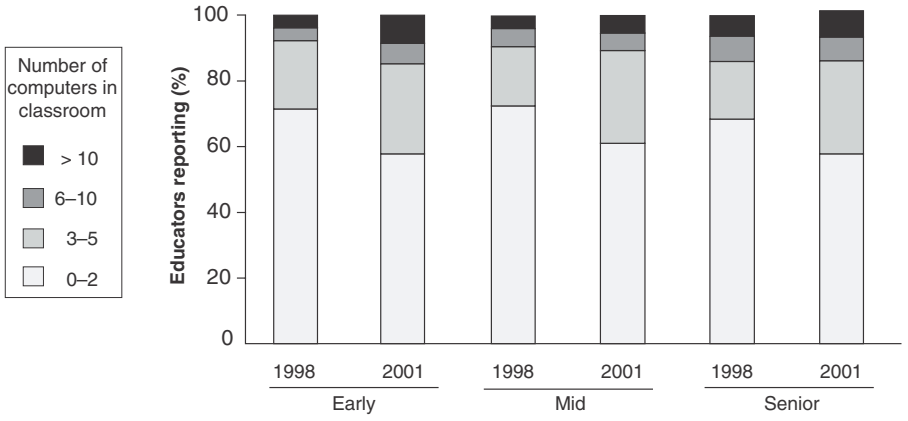
Table 7. Technology Improved Job Effectiveness (percentages of instructional staff only responding affirmatively)

Improved somewhat or very much	Educator responses (%) 1998	2001	% increase
Word processing of tests, handouts, and other written materials	83.2	87.4	4.15
Accessing new information through Internet and the Web	49.2	80.8	31.64
Individualizing instruction	56.5	71.5	15.04
Varying instruction by using multimedia or other technologies	53.1	69.4	16.32
Reinforcing skills through drill and practice	54.5	69.1	14.59
Working with more students	39.6	53.7	14.16
Helping students attain goals and standards	50.9	76.3	25.41

the most salient of these differences but also highlights areas of concern that may warrant further exploration. A discussion of these differences is offered in the Conclusions and Recommendations chapter of this report.

Demographic characteristics examined here include (a) years of full-time work experience as an educator, (b) school poverty level, (c) school grade level, and (d) geographical region.

Figure 2a. Educators at Different Career Levels Reporting on the Numbers of Computers for Students' Use in the Classroom (%)



Educators reporting (%) by career level

Number of computers in classroom	Early		Mid		Senior	
	1998	2001	1998	2001	1998	2001
> 10	3.8	8.5	3.8	5.3	6.2	8.1
6–10	3.9	6.3	5.5	5.4	7.8	7.4
3–5	20.8	27.4	18.1	28.2	17.6	28.8
0–2	71.5	57.8	72.6	61.0	68.5	58.8

Note: **Early career level:** 17.5 percent had no computers in 1998, and 10.7 percent had no computers in 2001.
Mid-career level: 19.9 percent had no computers in 1998, and 9.0 percent had no computers in 2001.
Senior career level: 21.4 percent had no computers in 1998, and 11.6 percent had no computers in 2001.

Figure 2b. Educators at Different Career Levels Reporting that Students' Main Access to Computers Is in the Classroom (%)

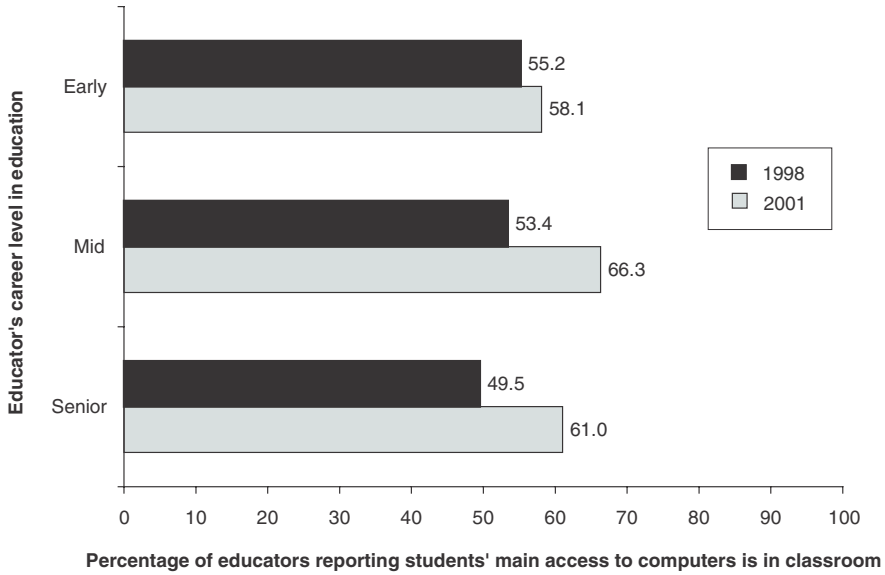
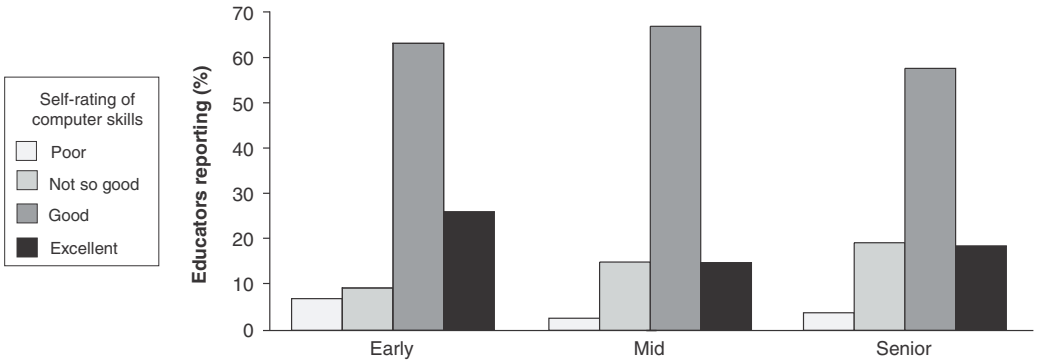


Figure 2c. Self-Ratings of Computer Skills for Educators at Different Career Levels, 2001 (%)



Self-rating of computer skills	Educators reporting (%) by career level		
	Early	Mid	Senior
Poor	7.0	2.7	3.9
Not so good	9.4	15.1	19.4
Good	63.5	67.0	58.0
Excellent	26.3	15.0	18.7

Educators' Years of Work Experience

Technology Access

Because almost all staff had just a few computers in their classrooms, access to computer hardware in the classroom did not differ much based on the number of years educators had worked in the field full time (Figure 2a).[7]

However, early career staff were more likely to describe the software for students as adequate (84.3%), and they were less likely to describe old or obsolete equipment as an obstacle. Yet, fewer early career educators provided their students' main access to computers in the classroom (58.1%; Figure 2b). Fewer had main access to the Internet or e-mail (69.6%) in the classroom (Table 8). They also had less access to TV (69.6%) and cable TV (45.6%) in their classrooms.

Mid- and senior career educators had similar access to technology. However, compared with senior career educators, more mid-career educators provided their students' main access to computers in the classroom. At the same time, mid-career educators were much more likely to describe the lack of technology funds as an obstacle to their job effectiveness (62.8%). Senior career educators were more likely to feel that teachers and ESP staff were not involved in school decisions to purchase new technology and were more likely to cite a lack of good instructional software (50.0%).

Technology Resources, Training, and Use

Early career staff were much more likely to rate their own computer skills as excellent or good (89.8%; Figure 2c). Fewer indicated a lack of time to learn about technology as an obstacle (75.5%; see Table 8). Substantially more early career educators also believed that their training on integrating technology into instruction was adequate (68.8%) and more tended to surf the Web at school than did other educators (49.7%). Also, newer educators were more likely to work in schools with a home page on the Web (84.2%) and more likely to consider maintenance of technology in their school as adequate (76.5%).

Mid-career educators had less confidence in their training on technology. Substantially fewer educators in the middle stages of their careers considered their training on using existing computer equipment and software as adequate (63.8%); fewer reported having adequate training on accessing online services (60.6%); and fewer than in any other group characterized their training on integrating technology into instruction as adequate (53.2%). However, mid-career educators tended, more than other educator groups, to use technology for indirect instruction, such as for word processing of instructional materials (79.0%), and sharing ideas with other teachers (20.3%).

[7] Years of experience are categorized as follows: early career level, less than 1 year through 10 years; mid-career level, 11–20 years; and senior career level, more than 20 years. (The introduction provides percentages in each demographic group.)

Table 8. Technology Issues and Years of Work Experience in Education (percentages of educators responding affirmatively)

	Career level					
	Early		Mid-		Senior	
Issue	% in 2001	% gain since 1998	% in 2001	% gain since 1998	% in 2001	% gain since 1998
TECHNOLOGY ACCESS						
Main access to Internet/e-mail in classroom or primary work area	**69.6**	**32.91**	**78.2**	**42.56**	**77.0**	**39.88**
Main access to a television in classroom or primary work area	69.6	9.08	76.9	15.13	77.4	12.50
Main access to cable TV in classroom or primary work area	**45.6**	**12.54**	**55.1**	**17.86**	**54.6**	**13.31**
Old/obsolete equipment an obstacle	48.4	–4.83	53.0	–3.93	50.0	–7.72
Lack of funds for computers, software, other tech. an obstacle	**50.1**	**–11.80**	**62.8**	**–1.44**	**54.3**	**–10.52**
Lack of good computer software for instructional use an obstacle	**38.5**	**–14.01**	**44.7**	**–11.57**	**50.0**	**–7.22**
Software for students adequate	**84.3**	**17.47**	**75.8**	**13.83**	**77.2**	**16.20**
Teachers or support personnel involved in decisions for buying new computers, other new technology	78.8	6.11	76.3	–1.08	71.6	–1.78
TECHNICAL RESOURCES AND TRAINING						
Maintenance of computer, television, and video equipment adequate	76.5	9.37	71.7	9.30	70.6	14.13
Training on existing equipment and software is adequate	**78.5**	**23.00**	**63.8**	**9.21**	**73.0**	**22.76**
Training on accessing on-line services is adequate	**73.3**	**24.87**	**60.6**	**13.44**	**71.8**	**28.67**
Training on integrating technology into instruction adequate	**68.8**	**26.49**	**53.2**	**13.31**	**58.6**	**21.30**
Unfamiliarity with computers an obstacle	**28.9**	**–12.55**	**44.3**	**–4.39**	**47.5**	**–9.49**
Lack of time to learn about new technology an obstacle	75.5	–1.84	82.1	–4.47	82.9	–1.54
Rate (own) computer skills as good or excellent	**89.8**	**7.34**	**82.3**	**10.53**	**76.7**	**12.61**
TECHNOLOGY USAGE						
Have used word processing software for instructional purposes[a]	75.5	26.59	79.0	34.99	73.7	28.64
Have used CD-ROM for instruction [a]	49.3	10.12	52.7	15.99	43.9	12.74
Surf Web at school weekly	**49.7**	**39.79**	**40.5**	**33.55**	**42.3**	**36.38**
Surf Web outside school weekly	**65.2**	**58.41**	**66.2**	**58.27**	**57.4**	**51.15**
Send/read e-mail outside school weekly	**58.9**	**42.90**	**61.1**	**49.02**	**50.8**	**35.14**
Share teaching ideas with other teachers using computer technology outside school	14.6	11.65	20.3	12.64	15.5	10.64
Have communicated with parents via e-mail [a]	54.3	–5.11	54.3	40.71	48.7	37.30
School has home page on Web	84.2	37.32	78.1	35.69	76.7	30.11
Technology has helped students attain goals and standards	80.9	30.91	77.0	23.53	75.8	26.68

Note: Bolded items show a difference of 10 percent or greater between two or more of the groups; other items show at least a 5 percent difference between the groups. [a]Instructional staff only.

More senior career staff had received adequate technology training than did mid-career staff, but senior career staff also had less confidence in their abilities. Fewer senior career educators rated their technology skills highly (76.7%) compared with the other groups. Although educators at all levels surfed the Web more outside of school, senior career educators were less likely to do so. Fewer used either Internet or e-mail outside of school (57.4% and 50.8%, respectively). The longer educators had worked in the profession, the less likely they were to believe that technology had helped their students attain their achievement goals and standards (80.9% for early career; 77.0% for mid-career; and 75.8% for senior career).

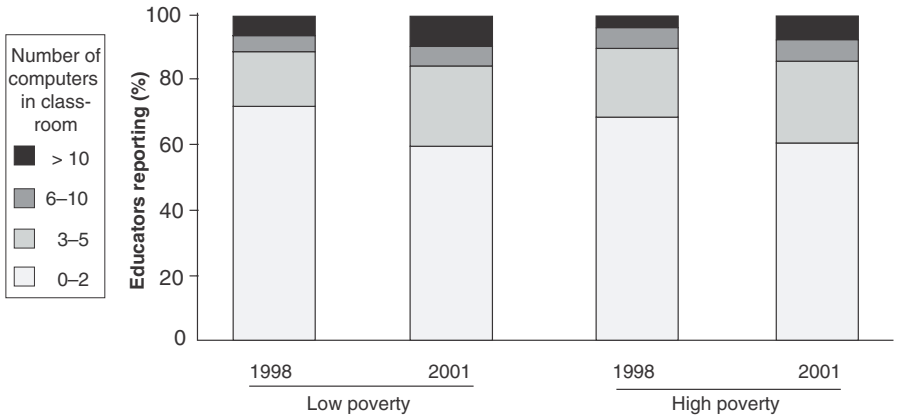
Poverty Level

Technology Access

Access to computers in the classrooms for students' use, was not much different for schools with different levels of poverty (Figure 3a).[8] However, numerous other differences are apparent between low-poverty and high-poverty schools. Low-poverty schools tended to have slightly more computers in their computer labs (mean, 30.85; standard deviation, 19.08) compared with high-poverty schools (mean, 25.18; standard deviation, 15.56). In addition, educators in low-poverty schools were more likely to believe that their computers had adequate capacity (81.1%) compared with those in high-poverty schools (75.2%); and fewer educators in the low-poverty schools characterized old or obsolete equipment as an obstacle to their job effectiveness (46.6%) compared with those in high-poverty schools (53.0 percent; Figure 3b). Also, more educators in low-poverty schools said that software for teachers was adequate (77.5%) compared with educators in high-poverty schools (71.7%).

Yet, although the technology in high-poverty schools was much less adequate, more educators in high-poverty schools provided their students' main access to computers in the classroom or primary work area (68.5%) compared with those in low-poverty schools (56.1%; Figure 3c). Educators also made substantial gains in acquiring access to the Internet in the classroom. The proportions of edu-

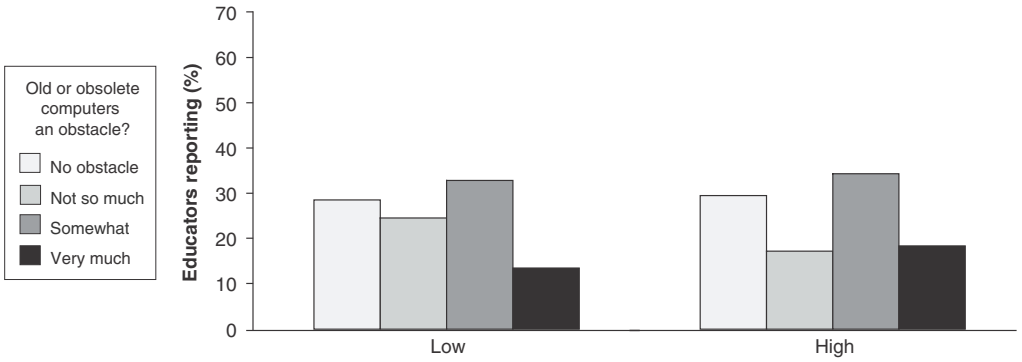
Figure 3a. Educators in Low- and High-Poverty Schools Reporting on Numbers of Computers for Students' Use in the Classroom (%)



Number of computers in classroom	Educators reporting (%) by poverty level of school			
	Low poverty		High poverty	
	1998	2001	1998	2001
> 10	6.0	9.3	3.6	7.3
6–10	4.9	6.0	6.4	6.7
3–5	16.9	24.8	21.2	25.2
0–2	72.2	59.9	68.9	60.9

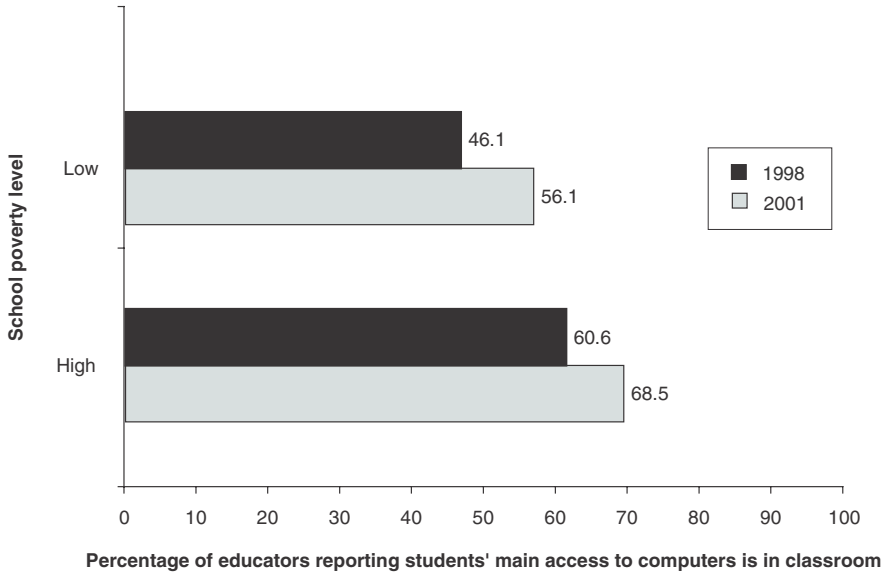
[8] School poverty level is derived from the number of students eligible for free or reduced-price lunch, which in turn determines whether schools are permitted to operate a "schoolwide" Title I program. The high-poverty level is 40 percent or more students eligible for free or reduced-price lunch; the low-poverty level is less than 40 percent of students eligible (NCES 2003b).

Figure 3b. Old or Obsolete Computers are an Obstacle



Old or obsolete computers an obstacle?	Educators reporting (%) by school's poverty level	
	Low	High
No obstacle	28.7	29.7
Not so much	24.7	17.3
Somewhat	33.0	34.5
Very much	13.6	18.5

Figure 3c. Educators at Low- and High-Poverty Schools Reporting that Students' Main Access to Computers Is in the Classroom (%)



cators who identified the classroom as their students' main point of access to the Internet were almost the same in high-poverty schools (74.0%; a 41% increase) as in low-poverty schools (73.6%; a 34% increase).

Technology Training and Use

Educators in low-poverty schools were more likely to feel that their training in using online services was adequate (71.1%; 24% increase), and substantially more educators in low-poverty schools sent e-mail from school (56.7%; a 35% increase) compared with those in high-poverty schools (40.8%; a 25% increase). Sizable gains were made among all educators in communicating with parents by e-mail, with educators working in low-poverty schools showing the largest increase (58.6%; a 44% increase) compared with those in high-poverty schools (35.1%; a 28% increase). Educators in low-poverty schools were also more likely to exchange instructional information with other teachers via computer (36.6%; a 22% increase),

Table 9. Technology Issues and School Poverty Level (percentages of educators responding affirmatively)

	School poverty level			
	Low		High	
Issue	% in 2001	% gain since 1998	% in 2001	% gain since 1998
TECHNOLOGY ACCESS				
Capacity of computers is adequate	81.1	13.52	75.2	11.77
Software programs for teachers (e.g., word processing, graphics, programs to calculate grades) are adequate	77.5	7.97	71.7	21.49
Old or obsolete equipment is an obstacle	46.6	– 8.48	53.0	–3.26
TECHNOLOGY TRAINING				
Training on how to access online services is adequate	71.1	23.61	65.8	20.92
TECHNOLOGY USAGE				
Have used word processing software for instruction[a]	76.3	26.55	68.3	31.27
Have used hypermedia/multimedia software for instruction[a]	27.1	7.55	22.0	9.12
Surf the Web weekly from school	**46.7**	**40.18**	**35.5**	**27.34**
Send e-mail from school weekly	**56.7**	**35.07**	**40.8**	**24.49**
Communicate with parents by e-mail	**58.6**	**44.37**	**35.1**	**27.48**
School has a home page on the Web	**82.0**	**31.00**	**70.1**	**33.97**
Exchanged instructional information with a teacher at another school via computer[a]	**36.6**	**22.27**	**26.2**	**16.58**
Improved word processing of test, handouts, and other written materials[a]	89.7	1.28	81.5	9.31
Improved accessing new information through the Internet and World Wide Web[a]	83.3	29.12	75.2	35.85
Improved reinforcing skills via drill and practice[a]	67.5	15.18	73.8	13.40
Improved varying instructional delivery by using multimedia and other technologies[a]	**72.0**	**17.44**	**64.0**	**13.26**
TECHNOLOGY PERCEPTIONS				
Believe the Association should have a role in providing technology training for members	69.2	–0.66	76.4	5.56
Believe the Association should provide education-related techology training for parents	**53.9**	**–0.82**	**68.5**	**8.79**

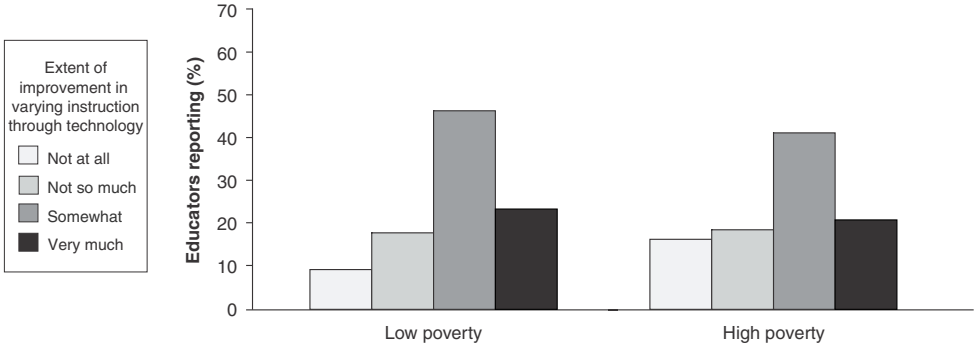
Note: Bolded items show a difference of 10 percent or greater between two or more of the groups; other items show at least a 5 percent difference between the groups. [a]Instructional staff only.

compared with educators in high-poverty schools (26.2%; a 17% increase). In addition, most educators in low-poverty schools tended to work in schools with home pages providing public information on the Web (82.0%), compared with educators in high-poverty schools (70.1%). More educators in low-poverty schools tended to surf the Web from school (46.7%; a 40% increase) compared with those in high-poverty schools (35.5%; a 27% increase). More educators in low-poverty schools used the Internet to improve their access to new information (83.3%; a 29% increase) compared with those in high-poverty schools (75.2%; a 36% increase; Table 9).

The impact of technology on direct instruction also varied by school poverty level. Instructional staff (i.e., teachers and paraeducators) in high-poverty schools used technology to reinforce student skills through drill and practice (73.8%) compared with those in low-poverty schools (67.5%). Educators in high-poverty schools were more likely to use technology to improve variation in instructional delivery (72.0%) compared with staff in high-poverty schools (64%; Figure 3d).

In addition, educators working at schools with different levels of poverty differed in their views on the role their professional Association should have in providing technology resources, whereas such differences were not

Figure 3d. Improvement in Varying Instructional Delivery via Multimedia and Other Technology



Extent of improvement in varying instruction through technology	Educators reporting (%) improvement in varying instruction through technology by school's poverty level	
	Low poverty	High poverty
Not at all	9.6	16.9
Not so much	18.4	19.2
Somewhat	47.8	42.5
Very much	24.2	21.5

found among educators based on other demographic characteristics. Educators in high-poverty schools were more likely to feel that their Association should have a role in providing technology training for members (76.4%), compared with those in low-poverty schools (69.2%), and they further believed that the Association should provide education-related technology training for parents (68.5%) compared with those in low-poverty schools (53.9%).

Level or Type of School

Technology Access

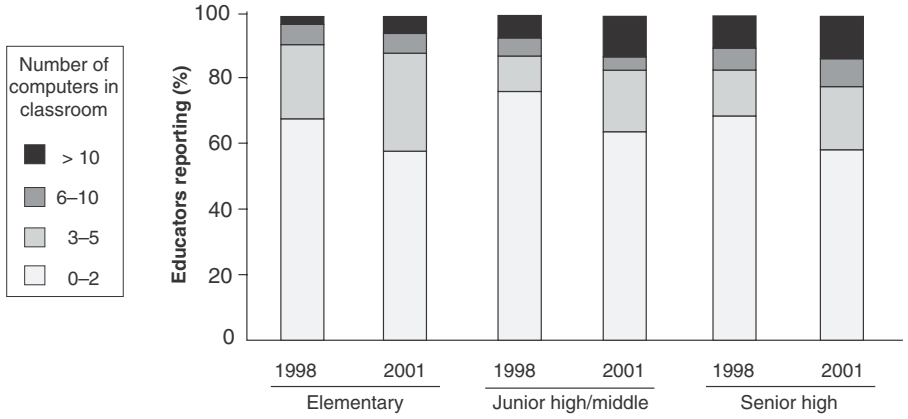
Although more than half of the educators at all school levels had one or two computers in the classroom, slight increases can be seen with increases in school level (Figure 4a). As noted, increases are found in the number of classrooms now with three to five computers, but secondary schools experienced the greatest gains in access beyond five computers. However, educators in elementary schools (71.3%) were much more likely to report that their classroom computers were the main computers used by their students in school (Figure 4b), although they were more likely to consider their computers old or obsolete (52.3%) and less likely to say that they were receiving adequate maintenance on computers and other technology (69.5%; see Table 10, in the next subsection). Elementary schools also had fewer other types of technology (e.g., TV, VCR, and cable TV) in the classroom than secondary schools, as well as fewer computers in the computer labs (mean, 24.5; standard deviation, 13.68) compared with labs in middle schools (mean, 33.4; standard deviation, 18.75) and senior high schools (mean 35.16; standard deviation, 23.15).

However, slightly more classrooms in elementary and middle schools provided students with their main access to the Internet (75.3% and 77.1%, respectively), compared with classrooms at the senior high level (72.1%). Also, more elementary and middle school staff characterized their software for students as adequate (79.9% and 80.6%, respectively), and more in middle schools further stated that software for teachers was adequate (82.5%). Middle school staff were also more likely to be involved in school decisions to purchase new technology (79.6%), and staff in elementary and middle schools were less likely than staff in senior high to report a lack of funds for technology as an obstacle (54.8%, 50.0%, and 61.3%, respectively).

Technology Resources, Training, and Use

Although educators differed less in their access to technical support and training than in other areas, these findings suggest trends that educators should monitor closely. More educators in elementary and middle schools had adequate technical support for equipment and software (68.3% and 67.4%, respectively) than did those in senior high schools (63.2%), whereas more staff in senior high and middle schools had adequate equipment maintenance (74.1% and 76.3%, respectively) than did staff in elementary schools staff (69.5%; Table10).

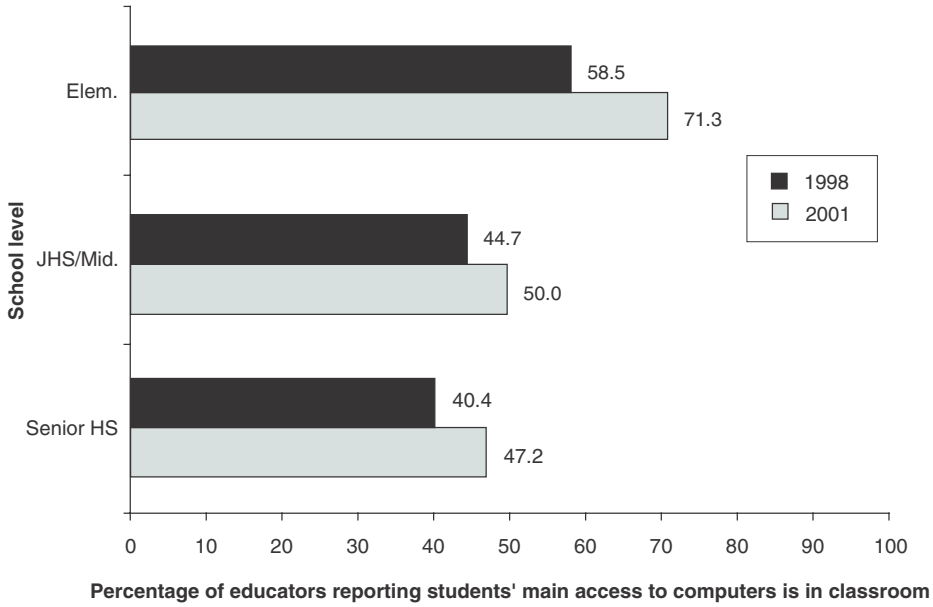
Figure 4a. Educators at Different School Levels Reporting on Numbers of Computers for Students' Use in the Classroom (%)



Educators reporting (%) by school level

Number of computers in classroom	Elementary		Junior high/middle		Senior high	
	1998	2001	1998	2001	1998	2001
> 10	2.4	5.2	6.2	12.2	10.3	13.3
6–10	6.3	6.1	5.6	4.1	6.7	8.6
3–5	22.9	30.3	11.0	19.1	14.1	19.4
0–2	68.4	55.4	77.1	64.6	68.9	58.5

Figure 4b. Educators at Different School Levels Reporting that Students' Main Access to Computers Is in the Classroom (%)



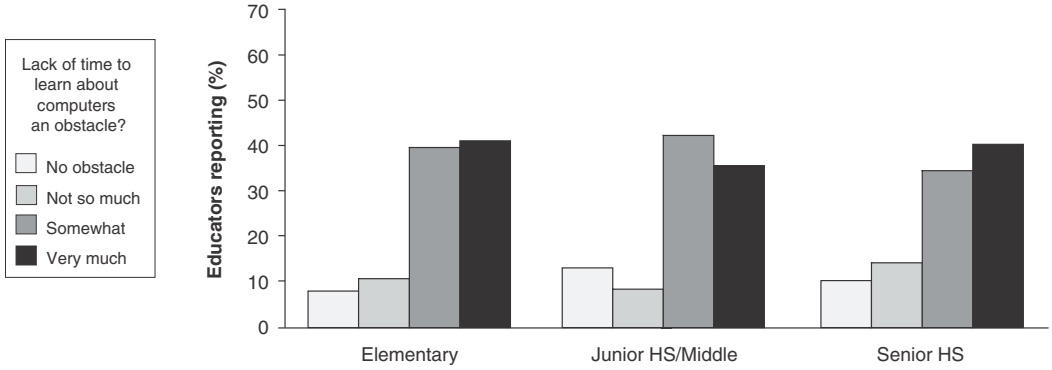
All educators reported substantial increases in using the Internet, but elementary school staff were the least likely to report surfing the Web at school (35.6%; a 29% increase), and those in senior high were the most likely to surf the Web outside of school (67.8%; a 58% increase). However, educators at each school level did report surfing the Internet more outside of school. The lack of time to learn new technology figured as less of an obstacle at the higher grade levels (81.1%, 75.2%, and 75.3% for elementary, junior high/middle school, and senior high school,

Table 10. Technology Issues and School Grade Level (percentages of educators responding affirmatively)

	School level					
	Elementary		Junior high / middle		Senior High	
Issue	% in 2001	% gain since 1998	% in 2001	% gain since 1998	% in 2001	% gain since 1998
TECHNOLOGY ACCESS						
Main access to Internet/e-mail is in classroom or primary work area	75.3	40.14	77.1	35.36	72.1	36.27
Main access to TV is in classroom or primary work area	**66.6**	**8.75**	**77.9**	**14.60**	**79.7**	**12.07**
Main access to a VCR is in classroom or primary work area	**64.1**	**11.69**	**70.6**	**13.20**	**76.4**	**14.52**
Main access to cable TV is in classroom or primary work area	**47.9**	**9.95**	**59.4**	**19.40**	**57.8**	**20.12**
Software for teachers is adequate	**73.5**	**15.16**	**82.5**	**8.33**	**76.8**	**8.66**
Software programs for students (e.g., word processing, graphics, remedial packages, individualized instruction, games) are adequate	79.9	16.55	80.6	17.70	75.7	13.09
Old/obsolete equipment an obstacle	52.3	–3.99	44.9	–10.10	44.9	–9.89
Lack of funds for computers, software, other technology an obstacle	**54.8**	**–6.75**	**50.9**	**–9.88**	**61.3**	**–5.94**
Teachers or support personnel are involved in decisions for buying new computers, new technologies	73.9	–0.81	79.6	12.42	73.5	0.36
TECHNICAL RESOURCES AND TRAINING						
Technical support for equipment and software is adequate	68.3	11.50	67.4	8.72	63.2	15.15
Maintenance of computer, TV, video equipment is adequate	69.5	7.73	76.3	16.16	74.1	9.83
Training on integrating technology into instructional process is adequate	60.2	19.39	60.8	10.67	55.9	23.74
Training on how to access online services is adequate	66.2	21.68	69.5	16.05	74.6	27.46
Lack of time to learn about new technology is an obstacle	81.2	–3.56	78.3	–5.48	75.3	–4.82
Unfamiliarity with computers or lack of computer training is an obstacle	44.0	–10.02	41.3	–1.79	38.7	–12.49
TECHNOLOGY USAGE						
Communicated with parents via e-mail	**42.1**	**31.06**	**56.7**	**48.88**	**64.4**	**49.60**
School has home page on the Web	**73.8**	**35.17**	**82.1**	**30.11**	**84.5**	**29.30**
Send/read e-mail at school	**49.1**	**30.00**	**59.4**	**38.02**	**56.0**	**34.02**
Send/read e-mail outside of school	55.1	41.93	50.3	36.20	55.4	32.31
Share teaching ideas with other teachers using computer technology at school	**27.6**	**23.38**	**39.4**	**34.22**	**34.3**	**26.40**
Surf the Web weekly from school	**35.6**	**29.44**	**52.3**	**45.53**	**53.5**	**43.70**
Surf the Web weekly outside school	**60.8**	**53.99**	**57.5**	**49.79**	**67.8**	**57.91**
Improved varying instructional delivery[a]	**66.6**	**14.57**	**76.2**	**25.94**	**70.5**	**14.56**
Improved word processing of test and other materials[a]	**83.9**	**5.44**	**92.9**	**5.75**	**90.1**	**–1.00**
Improved reinforcing skills through drill and practice[a]	**75.2**	**8.55**	**62.8**	**25.64**	**63.4**	**22.49**
Improved accessing new information through the Internet[a]	**75.5**	**32.92**	**82.3**	**29.49**	**90.2**	**29.70**

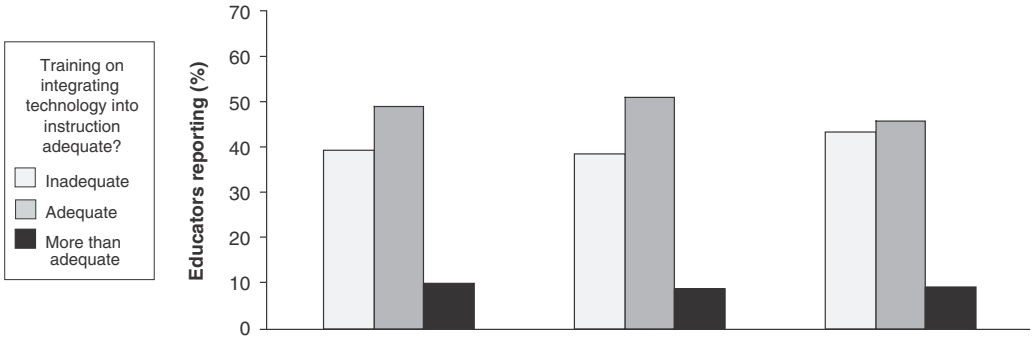
Note: Bolded items show a difference of 10 percent or greater between two or more of the groups; other items show at least a 5 percent difference between the groups. [a]Instructional staff only.

Figure 4c. Lack of Time to Learn about Technology Is an Obstacle



Lack of time to learn about computers an obstacle?	Educators reporting (%) by school level		
	Elementary	Junior HS/Middle	Senior HS
No obstacle	8.1	13.2	10.4
Not so much	10.8	8.5	14.3
Somewhat	39.8	42.5	34.7
Very much	41.3	35.8	40.5

Figure 4d. Adequacy of Training on Integrating Technology into Instruction



Training on integrating technology into instruction adequate?	Educators reporting (%) by school level		
	Elementary	Junior HS/Middle	Senior HS
Inadequate	39.8	39.2	44.1
Adequate	49.8	51.9	46.6
More than adequate	10.4	8.9	9.3

respectively; Figure 4c), and educators in senior high school were more likely to receive adequate training on using online services (74.6%; a 20% increase). In using technology to communicate, educators tended to communicate more with parents through e-mail, as the school level increased (42.1%, 56.7%, and 64.4%, respectively), and schools at the higher grade levels were more likely to have a home page on the Web (73.8%, 82.1%, and 84.5%, respectively). Educators in elementary schools were the least likely to use a computer to share teaching ideas with another teacher (27.6%; a 23% increase) and least likely to use e-mail at school (49.1%; a 30% increase). Those in middle schools were less likely to use e-mail outside of school (50.3%; a 36% increase).

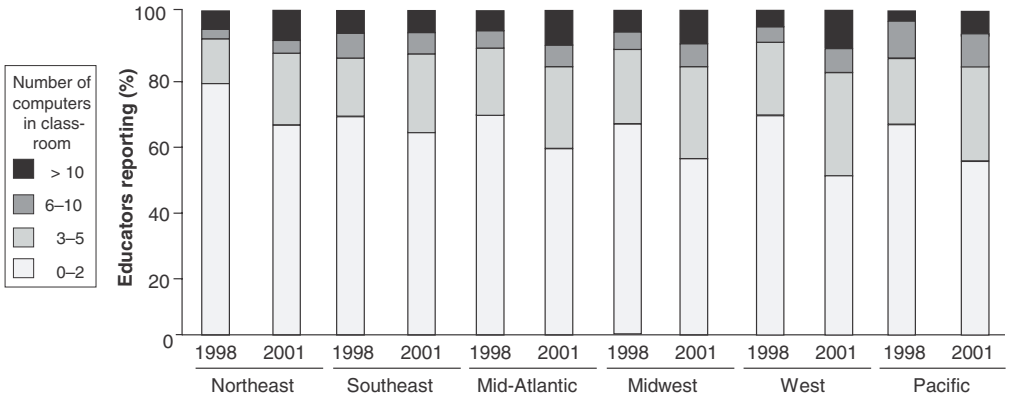
For direct instructional purposes, fewer senior high educators described themselves as having adequate training on integrating technology into instruction (55.9%; Figure 4d). However, educators in the secondary schools, particularly middle schools, were more likely to vary instructional delivery (76.2%; a 26% increase), whereas more at the elementary level used technology to reinforce student skills through drill and practice (75.2%). It is

noted, however, that staff in secondary schools were also increasingly using drill and practice activities with students (a 26% increase in middle schools and a 22% increase in senior high schools).

Geographical Region

In general, almost all regions increased in the number of computers in the classrooms or primary work areas for

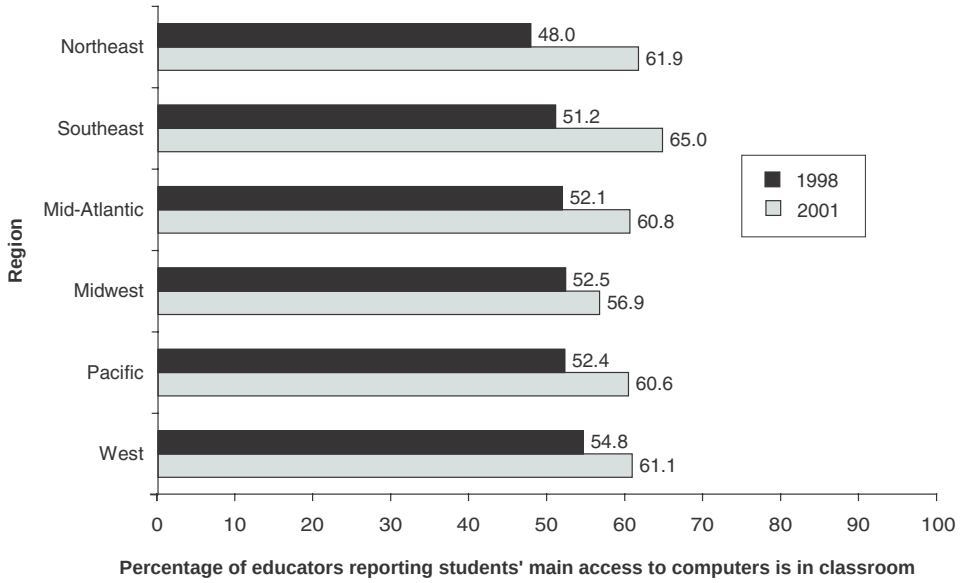
Figure 5a. Educators in Different Regions Reporting on Numbers of Computers for Students' Use in the Classroom (%)



Educators reporting (%) by region

Number of computers in classroom	Northeast		Southeast		Mid-Atlantic		Midwest		West		Pacific	
	1998	2001	1998	2001	1998	2001	1998	2001	1998	2001	1998	2001
> 10	5.7	9.0	6.8	6.6	6.0	10.2	6.3	10.0	4.8	11.1	3.0	7.6
6–10	2.9	4.0	7.7	6.6	5.4	6.6	5.4	7.1	4.8	7.1	11.3	8.8
3–5	12.6	20.9	17.1	22.3	19.3	23.4	21.3	26.2	21.6	30.2	19.0	28.2
0–2	78.9	66.1	68.4	64.5	69.3	59.5	66.9	56.7	68.8	51.6	66.7	55.3

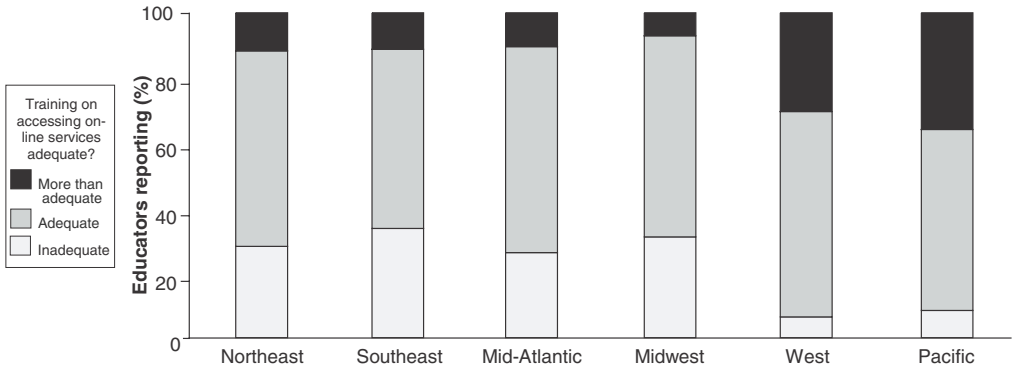
Figure 5b. Educators in Different Regions Reporting that Main Access to Computers for Students' Use Is in the Classroom



students' use (Figure 5a) and all regions, without exception, showed increases in their reliance on computers in the classroom (Figure 5b).[9] However, the Midwest and West seem to be leading in their use of the Internet in the classroom, and numerous other differences are notable between the NEA regions on educators' access to and training in using technology (Figures 5c and 5d).

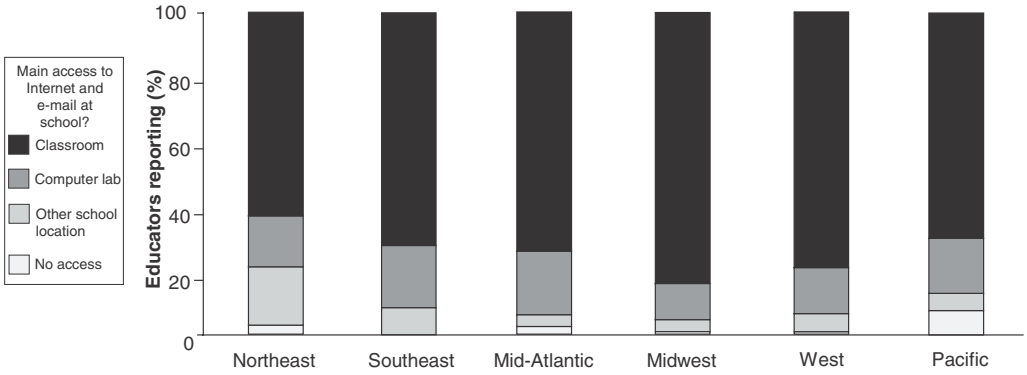
This report discusses each region separately, highlight-

Figure 5c. Adequacy of Training in Accessing Online Services, by Region



Training on accessing on-line services adequate?	Educators reporting (%) by region					
	Northeast	Southeast	Mid-Atlantic	Midwest	West	Pacific
More than adequate	11.7	11.2	10.4	7.1	30.4	35.9
Adequate	60.2	55.2	63.4	61.9	63.2	55.7
Inadequate	28.1	33.6	26.2	31.0	6.4	8.4

Figure 5d. Location of Main Access to Internet and E-Mail at School, by Region



Main access to Internet and e-mail at school?	Educators reporting (%) by region					
	Northeast	Southeast	Mid-Atlantic	Midwest	West	Pacific
Classroom	63.3	72.3	74.3	84.2	79.4	70.0
Computer lab	15.8	19.3	19.8	11.2	14.3	17.1
Other school location	18.1	8.4	3.6	3.7	5.6	5.3
No access	2.8	0.0	2.4	0.8	0.8	7.6

[9] The NEA administrative structure is divided by six regions of the country, which comprise the following states: Northeast – CT, MA, ME, NH, NJ, NY, PA, RI, VT; Southeast – AL, AR, FL, GA, LA, MS, SC, TN; Mid-Atlantic – DE, KY, MD, NC, OH, VA, WV; Midwest – IA, IL, IN, MI, MN, MO, ND, SD, WI; West – AZ, CO, KS, NE, NM, OK, TX, UT, WY; and Pacific – AK, CA, HI, ID, MT, NV, OR, WA.

ing areas in which each region led or lagged compared with the others. A Regional Overview section summarizes the findings for each region.

Northeast

The Northeast region had one of the largest increases (along with the Southeast) among staff whose students' main access to school computers was in the classroom or primary work area (61.9%; a 14% increase; see Figure 5b). However, it fell short of most other regions (except the Southeast) in providing access to computers in the classroom, with fewer reporting having more than two computers for students' use. The region also had fewer other types of technology in the classroom, such as a television (58.2%), VCR (55.4%), and cable TV (35.1%), and fewer had access to the Internet and e-mail than did educators in other regions (63.3%; a 32% increase). Also, compared with educators in other regions, fewer educators in the Northeast were involved in school decisions to purchase computers and other technology (65.0%). However, schools in the Northeast provided more loans to staff to purchase computers for home use, with nearly one-quarter (22.0%) of Northeast educators indicating that their districts provided low-interest or interest-free loans for computer purchases.

In using technology, educators in the Northeast were the least likely to receive adequate technical support for equipment and software (58.5%). Moreover, Northeast educators (along with the Pacific region) were among those gaining the fewest number of schools with home pages on the Web for sharing information with parents and the public (76.8%; a 29% increase), but they made greater gains than other regions in using e-mail outside of school to communicate (62.7%; a 50% increase. Further, the Northeast had the greatest gain in staff who improved in their reinforcement of students' skills through drill and practice (70.3%; a 23.06% increase), but these staff were the least likely to believe that technology was enabling them to work with more students (46.4%).

Southeast

Along with the Northeast region, the Southeast region had the fewest computers available in the classroom, with fewer educators reporting that they had more than two computers in the classroom for students' use. However, educators in this region experienced the largest amount of gain in certain other ways. Southeastern educators had the largest increase (along with the Northeast region) in using classroom computers as the main access for students (65.0%; a 14% increase) and the largest decline in staff, indicating lack of access to computers as an obstacle to their jobs (26.7%; a 20 percent decrease). Although educators in the Southeast also had the largest increase in providing students' main access to the Internet in the classroom (72.3%; a 45% increase), that region fell short of other regions in involving staff in decisions to purchase computer software (77.5%).

The Southeast had one of the largest increases (along with the Mid-Atlantic region) in staff reporting adequate training for using online services (66.4%; a 30% increase), and fewer identifying lack of time to learn about new technology as an obstacle (65.3%). The region also had the largest increase in staff reporting improvements in the word processing of instructional materials (84.5%; a 15% increase); the largest increase in varying instructional delivery (75.0%; a 28% increase); and the largest increase in training on integrating technology into instruction (67.8%; a 25% increase).

However, educators in the Southeast used e-mail the least at school (38.3%) and had the smallest increase in communicating with parents by e-mail (28.9%; a 23% increase). In addition, they also lagged behind other regions in the overall number of schools with home pages on the Web, although they had the greatest amount of gain in this area (65.0%; a 37% increase).

Mid-Atlantic

Although educators in the Mid-Atlantic had the largest increase in the number of schools involving teachers and ESPs in computer software decisions (86.8%; a 14% increase), the region had one of the smallest increases (along with the Pacific region) in the number of staff considering software for teachers as adequate (77.4%; a 7% increase). Compared with other regions, the Mid-Atlantic also had the smallest increase in educators believing that maintenance on school computer equipment was adequate (64.2%; a 3% increase).

Educators in the Mid-Atlantic region showed the largest increase in staff who considered their computer skills excellent or good (80.8%; a 16% increase) and (along with those in the Southeast region) were more likely to have had adequate training on integrating technology into instruction (67.7%). Like Northeast educators, those in the Mid-Atlantic showed one of the largest

increases in staff considering their training on accessing online services adequate (73.8%; a 30% increase), and they showed the largest increase in using e-mail at school (58.2%; a 44% increase).

Midwest

More educators in the Midwest believed that the capacity of their computers was adequate (87.1%), and more further believed that the software for students was adequate (86.8%). Compared with other regions, the Midwest had the largest increase in these areas (38% and 25%, respectively). The Midwest also had the largest number of staff providing their students' main access to the Internet in their classrooms (84.2%), and made the greatest gain in providing access to cable TV in the classroom (61.3%; an 18% increase).

West

Educators in the West had the most computers in the classrooms, with 18.2 percent reporting more than five computers in the classroom for students' use. Similar to their counterparts in the Midwest, educators in the West were more likely to consider the capacity of their computers as adequate (83.3%), and they showed the largest increase in educators who surfed the Web from school (55.6%; a 44% increase). Western staff were less likely to indicate unfamiliarity with computers or lack of training as an obstacle to their jobs, and they had the largest decline in this area (to 38.9%; a 17% decrease). They also had the greatest gain in staff believing that technology had improved their ability to work with more students (57.9%; a 23% increase).

Pacific

More educators in the Pacific region reported that school staff were involved in decisions to purchase school computers and other technologies (85.9%), and they showed the largest decline in educators who considered old or obsolete equipment as an obstacle (54.1%; 12% decline). However, the Pacific region (along with the Mid-Atlantic) had one of the smallest increases in educators who believed that maintenance on computer equipment was adequate (70.8%; a 5.54% increase). They also had one of the smallest increases (along with the Mid-Atlantic) in staff who believed that software for teachers was adequate (69.9%; an 8% increase), and they were more likely to believe that a lack of good computer software for instructional use was an obstacle to their jobs (52.4%). Similar to schools in the Northeast, schools in the Pacific region showed less gain than schools in other regions in acquiring home pages on the Web to share information with parents and the public (72.4%; a 28% increase).

Regional Overview

In sum, educators on the eastern side of the United States led in having adequate training on using technology for direct instruction, and they had more training on using the Internet. More educators in the Southeast and Mid-Atlantic regions were trained adequately on integrating technology into instruction, and more in the Southeast improved in varying instructional delivery. Also, more in the Northeast and Mid-Atlantic had received training on using online services.

Educators on the western side of the United States had more access to technology in the classroom and more support for technology. Educators in the West region had larger numbers of computers in the classrooms, and more in the Midwest and West regions believed that their computer capacity was adequate. They also had greater access to the Internet, and those in the Midwest were also more satisfied with their software for students. Educators in the West and Midwest had fewer old or obsolete computers, and more Pacific region educators believed that maintenance of equipment was adequate. Table 11 provides a comprehensive picture of all regions.

Educators' Attitudes toward Education Technology

The attitudes of public school educators toward education technology have strong implications for its use in teaching and learning; in particular, educators who feel positively about technology are more likely to use it effectively. Whether an increasingly positive attitude toward an effective use of technology is a continuing process may be called into question by results of the NEA's 2001 survey. That is, the 2001 survey found a decline in the number of educators who considered the role of technology in teaching and learning as "essential." Additional analyses employing multiple regression techniques[10] helped to clarify the relationships between educators' experiences with

[10] Multiple regression analyses identified significant, independent relations between educators' attitudes and particular technology experiences examined in the survey. See Appendix C for the table of standardized regression (β) coefficients.

Table 11. Technology Differences by Geographical Region (percentages of educators responding affirmatively)

	Northeast		Southeast		Mid-Atlantic		Midwest		Western		Pacific	
Technology issue	% in 2001	% increase	% in 2001	% increase	% in 2001	% increase	% in 2001	% increase	% in 2001	% increase	% in 2001	% increase
TECHNOLOGY ACCESS												
Main access to cable TV in classroom/primary work area	35.1	12.52	51.8	10.43	58.9	14.55	61.3	18.36	43.0	2.50	53.8	14.43
Main access to TV in classroom/primary work area	58.2	15.25	78.3	8.09	76.0	7.78	73.1	13.11	73.0	2.38	78.2	10.00
Main access to VCR in classroom/primary work area	55.4	13.56	71.1	14.05	70.7	10.78	68.6	14.04	69.8	7.94	77.1	11.76
Main access to Internet/e-mail in classroom/primary work area	63.3	31.64	72.3	45.00	74.3	40.72	84.2	38.33	79.4	34.92	70.0	35.88
Class/lab computers are connected to Internet	91.5	26.55	90.9	45.45	93.4	29.90	96.3	29.58	93.7	31.75	85.9	17.65
School dist. provides loans to purchase home computers	22.0	–1.69	9.9	0.83	15.7	–1.10	9.2	–0.83	7.9	–1.59	10.6	1.76
Lack of access to computers is an obstacle	36.2	–8.47	26.7	–20.44	31.1	–10.18	27.1	–14.17	34.1	–7.94	34.7	–15.29
Old or obsolete equipment is an obstacle	49.4	–7.07	46.6	–7.94	48.5	–5.99	44.8	–3.56	50.8	–0.79	54.1	–12.36
Software programs for teachers is adequate	72.8	16.90	78.4	21.42	77.4	7.38	81.4	12.68	83.2	14.15	69.9	7.59
Software programs for students is adequate	77.8	14.50	74.8	16.10	75.9	5.87	86.8	25.14	79.7	13.80	70.9	9.73
Lack of good instructional software is an obstacle	42.4	–12.93	40.2	–14.37	44.8	–6.65	42.6	–12.03	44.0	–12.35	52.4	0.03
TECHNICAL RESOURCES, TRAINING, AND SUPPORT												
Staff involved in decisions to purchase computers and new technology	65.0	–3.39	70.2	6.61	71.9	–0.60	77.5	2.08	76.2	5.56	85.9	5.88
Staff involved in decisions to purchase software	80.2	4.52	77.5	8.08	86.8	14.37	89.6	8.75	87.3	9.52	87.6	1.76
Capacity of school computers is adequate	74.4	6.07	79.2	17.18	78.4	11.38	87.1	20.83	83.3	17.46	71.8	5.88
Tech. support for equipment and software is adequate	58.5	7.68	67.2	17.65	69.9	14.19	73.6	12.81	70.6	15.08	64.1	12.35
Maintenance of computers and other tech. is adequate	71.0	15.66	69.8	16.94	64.2	3.16	77.4	11.99	77.0	19.84	70.8	5.54
Training on integrating tech. into instruction is adequate	55.8	17.96	67.8	24.85	67.7	23.97	58.8	18.33	56.3	11.11	56.5	18.90
Training on accessing online services is adequate	71.9	21.65	66.4	30.02	73.8	30.07	69.0	21.54	69.6	16.43	64.1	18.19
Lack of time to learn about new tech. is an obstacle	76.7	–2.96	65.3	–9.95	83.8	1.20	83.7	–5.07	80.2	–2.38	77.6	–2.94
Unfamiliarity with computers/lack of training an obstacle	43.5	–5.08	41.7	–8.75	43.7	–7.78	40.2	–13.17	38.9	–16.67	43.5	–4.71
TECHNOLOGY USAGE												
Communicated with parents via e-mail	49.2	37.29	28.9	23.14	55.7	44.91	55.8	42.50	56.3	42.06	47.6	35.88
School has home page on Web	76.8	28.81	65.0	36.90	83.2	33.53	82.9	36.67	85.7	38.10	72.4	27.65
Send/read e-mail at school	44.9	34.15	38.3	26.76	58.2	43.81	62.9	33.75	57.9	30.95	47.9	22.63
Send/read e-mail outside school	62.7	50.28	45.0	31.78	58.4	41.67	47.1	28.75	54.0	33.33	59.2	43.29
Surf the Web at school	42.0	39.22	38.3	29.24	42.5	34.13	48.3	39.58	55.6	44.44	36.1	28.45
Share teaching ideas via computer at school	29.5	28.42	33.9	27.27	37.3	31.36	31.4	26.38	36.8	27.28	26.0	17.80
Share teaching ideas via computer outside school	15.3	14.21	21.5	12.40	18.7	12.69	12.6	6.72	24.0	19.24	18.2	11.18
TECHNOLOGY IMPACT												
Improved word processing of class materials	87.6	7.31	84.5	14.85	93.6	11.51	85.7	0.62	91.7	4.02	84.8	–3.32
Improve working with more students	46.4	8.94	56.0	12.53	52.3	14.73	58.4	15.58	57.9	23.34	53.0	14.38
Improve reinforcing student skills via drill/practice	70.3	23.06	76.1	13.52	67.3	–0.24	69.5	14.70	63.6	11.88	67.5	17.80
Improved accessing new information via Web	83.2	33.91	70.9	31.52	84.6	32.62	83.2	30.78	80.0	30.00	76.4	30.67
Improved varying instructional delivery	66.0	13.27	75.0	27.53	71.8	18.46	74.6	18.51	62.0	11.11	63.6	11.98

technology and their attitudes toward it. An understanding of which experiences are more strongly associated with positive attitudes toward technology could help education policy makers channel resources for technology more effectively. Results of these analyses showed not only that significant relationships do exist between certain educators' attitudes toward education technology and their experiences with it but also that these relationships become more complex over time. Among the attitudes examined in the context of educators' experience were their (a) confidence in using technology; (b) fondness for technology; and (c) ascription of value to technology in teaching and learning.

Confidence in Using Technology

In 2001, the majority of educators rated their own computer skills as high, with 61.8 percent characterizing their skills as good (a 12% increase since 1998) and 19.0 percent reporting that their skills were excellent. Less than one-fifth (19.2%) rated their skills as not so good or poor. As expected, in both 1998 and 2001, educators' ratings of their computer skills had the strongest relationship with their level of computer use and training. Educators who rated their skills highly were less likely to cite unfamiliarity with computers and lack of training as an obstacle to their job effectiveness (in 1998, $\beta = -.415$, $p < .001$; and in 2001, $\beta = -.314$, $p < .001$). (See Appendix C: Standardized Regression Coefficients.) Other experiences that appear to be associated with technology skills include access to technology resources and staff involvement in school technology decisions. In 1998 and 2001, educators who rated their technology skills more highly were more likely to believe that the software available for students' use was adequate (in 1998, $\beta = .137$, $p < .01$; in 2001, $\beta = .104$, $p < .05$). Yet in 2001, those who had rated their technology skills more highly were less likely to feel teachers and ESPs in their schools were involved in school decisions regarding technology purchases ($\beta = -.146$, $p < .01$).

Educators who described their skill levels as high also used technology in more advanced ways over time. In 1998, they were more likely to have reported simply that they had used e-mail ($\beta = .159$, $p < .001$), whereas in 2001 they were more likely to have reported using e-mail specifically outside of school ($\beta = .183$, $p < .001$) and to contact school parents ($\beta = .098$, $p < .05$). In 1998, educators with higher technology skills had shared teaching ideas outside of school using computer technology ($\beta = .102$, $p < .05$), but in 2001 they were more likely to have surfed the Web at school ($\beta = .126$, $p < .01$).

The perceived impact of technology on job performance also changed over time. In 1998, instructional staff (teachers and paraeducators) who rated their skills more highly indicated that technology had helped to improve their word processing of class materials ($\beta = .161$, $p < .001$). In 2001, those with higher technology skills were more likely to report that technology had improved their access to new information through the Internet ($\beta = .109$, $p < .05$). In both 1998 and 2001, those with higher technology skills were also more likely to report improvements in working with more students (in 1998, $\beta = .139$, $p < .01$; in 2001, $\beta = .097$, $p < .05$).

Fondness for Technology

More than three-fourths of educators (76.9%) said in 2001 that they "like" technology—a 2 percent increase since 1998—but 22.3 percent reported mixed feelings, and a few (0.7%) indicated "disliking" technology. Educators' fondness for technology in both 1998 and 2001 was most strongly associated with their level of familiarity with computers. That is, those who had more positive feelings about technology were less likely to indicate that their unfamiliarity or lack of computer training was an obstacle (in 1998, $\beta = -.199$, $p < .001$; in 2001, $\beta = -.126$, $p < .05$).

In 1998, educators who felt more positively toward technology were also more likely to complain that a lack of computer access was an obstacle to their job effectiveness ($\beta = .162$, $p < .01$), and they were less likely to report that their school had Internet connections in the classrooms and labs ($\beta = -.204$, $p < .001$). However, more did believe that their software for students was adequate ($\beta = .195$, $p < .01$), and they were more likely to work in schools that had home pages on the Web ($\beta = .174$, $p < .001$). In 2001, educators' fondness for computers reflected the adequacy of maintenance of the school's existing technology ($\beta = .124$, $p < .05$). Educators who were more fond of technology were also more likely to express a concern about the lack of funds to purchase new computers, software, and other technologies ($\beta = .129$, $p < .05$).

Educators who felt more positively about technology were more likely to use technology outside of school to communicate and share ideas. In 1998, those who liked technology more were more likely to support receiving communications from their professional association via e-mail, ($\beta = .105$, $p < .05$), and in 2001, they were more likely to send and receive e-mail outside of school ($\beta = .149$, $p < .05$), as well as to share teaching ideas ($\beta = .123$, $p < .05$).

However, beyond communications, educators who were fond of technology in both 1998 and 2001 had also improved in using the Internet to gather new information (in 1998, $\beta = .172$, $p < .01$; in 2001, $\beta = .111$, $p < .05$). Along with these changes, perceptions about using technology for direct instruction changed over time. Instructional staff (teachers and paraeducators) were more fond of technology in 1998 if it had helped to improve their word processing of class materials ($\beta = .133$, $p < .01$), and in 2001 their fondness for technology was highly associated with its role in helping them to work with more students ($\beta = .117$, $p < .05$).

Views of the Value of Technology

As noted earlier, slightly fewer educators (57.0%) considered technology as "essential" to teaching and learning in 2001 than did in 1998 (61%; a 4% decline). In 2001, 42.1 percent believed technology was "important but not essential," and a few (0.7%) believed technology was "not important." In 1998, educators who put a higher value on technology were more likely to support receiving communications via e-mail from their professional associations ($\beta = .106$, $p < .05$), but otherwise the value they ascribed to technology related only to its usefulness in the classroom. Those who valued technology highly in 1998 had used it to improve in their word processing of class materials ($\beta = .109$, $p < .05$) and were using technology to reinforce student skills ($\beta = .157$, $p < .01$). Also in 1998, educators were more likely to value technology if it had improved their access to new information ($\beta = .162$, $p < .02$) and improved their ability to work with more students ($\beta = .143$, $p < .05$).

In 2001, educators who valued technology were more likely to use it to individualize instruction ($\beta = .163$, $p < .01$) and to help students attain goals and standards ($\beta = .139$, $p < .05$). However, in 2001, educators who valued technology were less likely to consider their software for teachers as adequate ($\beta = -.146$, $p < .01$), and they were less likely to report that their schools had Internet connections in their classrooms and labs ($\beta = -.097$, $p < .05$).

Overview and Implications

Between 1998 and 2001, most public school educators rated their technology skills highly and expressed fondness for technology, but the value they put on technology as a tool for teaching and learning declined slightly. Educators' skills in using technology as well as their fondness for technology were more strongly associated with their training and familiarity with using computers than with other experiences. Their skills in using technology and their fondness for technology also pointed to their ability to use technology to communicate with others, gather information, and work with more students. It also reflected a shift in their priorities from wanting adequate software to wanting adequate hardware maintenance and upgrades. Yet, the actual value that educators placed on using technology in teaching and learning related only to its usefulness for direct instruction.

Educators' perceptions of technology changed between 1998 and 2001. In 1998, educators put a higher value on technology if it had helped to improve their word processing of class materials, reinforced student skills through drill and practice, and allowed them to access new information. In 2001, educators put a higher value on technology if it had helped them in individualizing instruction and in ensuring that students reached achievement goals and standards.

These findings suggest that public school educators who are skilled in using technology and hold positive beliefs about the value of technology in education have grown in their experiences with and expectations for using technology. Educators highly skilled in using technology are more likely to use technology in integrated ways. However, they are also more likely to not have adequate access in the classroom and not likely to be involved in school decisions regarding technology. These findings help clarify the impact of the demographic differences discussed earlier and go further to reveal trends that, over time, will affect educators' commitment to using technology for teaching and learning.

3

Conclusions and Policy Recommendations

The findings of this study are especially encouraging because of gains noted in computer hardware, software, technical support, and training of school personnel. However, the implementation of technology in schools, overall, has not kept pace with the expectations of highly skilled educators who are trying to integrate technology into their instruction, and inequities among particular demographic groups are still evident.

Recommendations presented here propose various ways in which states and school districts can meet these challenges, and critical goals are proposed for administrators to consider. In addition, these recommendations reiterate, reinforce, and update the actions and policy positions proposed by the NEA more than a decade ago through the NEA Special Committee on Telecommunications (NEA 1992).

The basis for these recommendations, however, goes beyond the research and policies of the NEA. It considers numerous other research studies and debates on crucial education issues in technology. Taken together, these studies provide an in-depth look at technology in public education. Research conducted at the national, state, and district system levels covers a broad spectrum of issues and yields varying results. This study could provide a bridge between these systemic levels by presenting a national-scale view directly from the classroom.

Issue 1. Technology Access

Conclusion: Students Lack Adequate Access to Computers in the Classroom

Most public school educators have access to a computer and the Internet in their school building and classroom, but the level of student access in the classroom is still inadequate. The NEA study found that almost all public school educators had access to a computer and to the Internet somewhere in their schools, and the majority had access to computers in their classrooms or primary work areas as well. However, most educators had access to just one or two computers in their classrooms, and only a few had more than five classroom computers for their students' use.

Recommendations and Other Relevant Research

Computers and the Internet should be made available in classrooms or primary work areas at a ratio that allows students to gain regular and unencumbered access throughout the school day. As reported by the U.S. Department of Education, for every five students, the average American classroom has one computer. That is a substantial increase from the 12:1 ratio reported in 1998 (NCES 2002a). Many experts consider this to be an adequate ratio for effective use of computers in schools (Valdez, McNab, Foertsch, and others 2000), but concerns have been raised about the computation of the national ratio. In short, the reported ratio is computed by "dividing the total number of students in all public schools by the total number of instructional computers with Internet access in all public schools (i.e., including schools with no Internet access)" (NCES 2002a). This, in effect, provides a nationwide snapshot that does not take into account the uneven distribution of technology across geographic locations, demographic groups, or even classrooms. Moreover, a recent survey of states and the District of Columbia does not show that any state, on average, has 5 students per computer with Internet access in the classroom, as suggested by the national ratio (*Education Week* 2003). Four states currently have a 15:1 ratio for computers with Internet access in the classroom; 31 states have 10 to 14 students per Internet computer in the classroom; and 15 states have 6 to 9 students per Internet computer in the classroom.

In arguing the case against a computer for every student, critics generally point to the cost of technology, to ongoing cuts in school budgets, and to the inadequate infrastructure of most schools to support more computers in the classrooms. However, advocates note that problems related to infrastructure are being addressed through the use of laptop computers, particularly by a new generation of wireless computers, which do not need a cable connection. They cite numerous examples of districts and school programs that already provide students with laptop computers, and they mention statewide initiatives in Maine and Texas, which had broad support even though they ultimately failed, and one in New York, which passed (Robinson 2000). Regarding the cost, technology advocates argue that computers seem expensive because they are put into the same budget category as pencils, and they reason that the actual cost of an adequate Internet-capable laptop computer would be less than $500 per student, with an expected lifetime of five years—an annual cost of $100 per year per student (Papert 1996). Yet, in 2002, only 8 percent of public schools lent laptops to students (mostly in rural areas), with only 16 percent of the schools lending the laptops to students for the entire school year (NCES 2003a). In 2001, an average of 10 computers were available for loan in the lending schools (NCES 2002b). Advocates further dismiss issues related to the security and damage of the laptops by recommending the rugged, institutional models currently being used by the U.S. military (Robinson 2000).

The findings of the NEA's study show that despite the scarcity of computers in the classrooms, staff and students are relying on these computers more than on the computers in the computer labs. These findings are further supported by other studies following the growing trend of classroom technology. For technology to become an integral part of the educational process, experts argue, it should be accessible to staff in their classrooms or primary work areas, and individual students must have ongoing access in order for it to be adopted as a reliable learning tool (Becker 1999). ***The NEA strongly recommends that educational policy makers and school administrators continue exploring avenues to bring more computers into public school classrooms and seek to better understand how the investment in more classroom computers can strengthen both teaching and learning.***

As recommended by the NEA Special Committee on Telecommunications (NEA 1992), NEA state affiliates should continue to monitor changes in state telecommunications regulations that will affect accessibility and affordability of advanced technologies in public schools. Now that the fundamental goal of providing every public school building with access to a computer and the Internet has been achieved, for the most part, this is not the ultimate goal for education technology. The ultimate goal is to ensure that every child has an equal opportunity to learn the skills necessary to compete effectively in the twenty-first century—the digital age.

Issue 2. Technology Resources and Support

Conclusion: Technical Support Is Inadequate

Technical support for existing school technology is inadequate for effective teaching and learning, particularly because a large portion of the existing technology is old or obsolete.

The NEA's study found that public school educators gained greater input in school decisions to purchase technology hardware and software between 1998 and 2001, yet nearly half still believed that old or obsolete equipment was an obstacle. Although educators described the maintenance of computer equipment as adequate, they were less inclined to believe that technical support (i.e., troubleshooting and upgrades) for their existing equipment was adequate, and improvements since 1998 were only slight.

Recommendations and Other Relevant Research

A more integrated and broad-scale approach to providing equipment upgrades and technical support should be devised through staff training and district planning. In order for schools to effectively use the technology they have accumulated, there needs to be adequate support for keeping the hardware functioning and upgraded, as necessary. Moreover, educators need technical support in troubleshooting problems and in setting up computers and other technology for demonstrations, projects, and other instructional activities if computers are to have an integrative function in the teaching process. Current trends in technical support range from sophisticated systems that use nonschool personnel or entities on a contractual basis to designated school personnel who provide technical support as needed and to middle and senior high school students who provide technical support on a voluntary basis.

Although the options for technical support vary depending on the needs of the staff and on the resources of the school, experts agree that to support school technology successfully there must be a clear commitment on the part of the school administration and the technical staff. They contend that (1) schools need to recognize that technology support staff must be available to perform their roles on a full-time basis; (2) the technical support personnel should understand both the educational process and the computer technology and must be committed to being a part of the school's planning process rather than just to being crisis managers who keep the machines running; and (3) schools and districts must plan and budget realistically to purchase technology and to maintain and upgrade it on a regular basis for it to be used effectively by staff and students (NCES 2002c). Unfortunately, however, a recent survey of states found that 9 of 26 states expect their districts to spend less money than they did in the previous year on technical support, and only 7 of the 26 expect their districts to spend more (*T.H.E. Journal* 2003).

The NEA continues to advocate for the position stated by the NEA Special Committee on Telecommunications (NEA 1992): ***The maintenance, technical support, training, evaluation, and staffing, as well as equipment purchases, must be fully funded. The Special Committee recommended that NEA encourage the development of public and private funding to allow schools to purchase, maintain, and upgrade technology.*** NEA state affiliates are now encouraged to take a leadership role in emphasizing the ongoing need for technology funds in public schools to district and state education administrators. Moreover, it should be stressed that the funding needs extend beyond the initial purchase and installation of computer hardware to include regular upgrades of equipment and training of the personnel who provide on-site support and equipment maintenance.

Issue 3. Technology Training

Conclusion: Educators Want More and Better Training in Using Technology for Instruction

Training on using technology has not been adequate to prepare most educators to use technology for instruction.

The NEA study found that public school educators gained greater familiarity with technology and were using it to help improve their job effectiveness but were still not comfortable with their level of training or knowledge about using technology for direct instructional purposes. They felt less confident about their training on using the Internet to collect and share information and had few opportunities to engage their students in any distance-learning activities. However, the greatest gains in training on technology were among senior career educators, who surpassed mid-career staff in their training but were still less confident in their skills. Educators in high-poverty schools also lagged behind their counterparts in low-poverty schools on technology training. Geographically, educators in the eastern part of the country made the most gains in technology training, with more reporting that their training on integrating technology into instruction was adequate, and fewer reporting that the lack of time to learn technology was an obstacle.

Recommendations and Other Relevant Research

Public school teachers and education support professionals should be given adequate opportunities to make decisions about and engage in high-quality professional development for using technology in their jobs. As shown in the NEA study and in other studies, most school staff members have greatly improved in using technology, but the majority still need training on using the Internet and on using technology for direct instructional process (North Central Regional Educational Laboratory 2000). Yet, because of rising demands on staff time during the school day and other professional development requirements, many educators find it difficult to allocate time to learning technology skills that are neither required nor mandated for instructional purposes. Therefore, alternative methods of professional development are being offered to help fulfill the need for technology training (National Staff Development Council 2001). An increasingly popular method is online professional development, which can be used not just for learning technology but also for academic subjects such as English, math, science, and social studies. Many proponents of e-learning not only praise the flexibility that it allows in scheduling but also the learning "communities" that are created as educators share and learn from each other (*Education Week* 2002a). Where staff have outdated computers and have difficulty downloading materials or viewing videos, many training courses are also being provided through CD-ROMs.

Even though 34 states and the District of Columbia have standards for teachers that include technology

(*Education Week* 2003), formal training for public school educators to use technology seems to be declining. Technology training accounted for only 14 percent of school technology spending in 2001 compared with 17 percent in 2000 (*Education Week* 2002b). Only 4 states require technology training for teacher recertification, and only 11 states require technology training for initial teacher licensure. Because only a few states have these requirements, advocates for school technology have been calling on the federal government to take a more proactive role in helping to fund teacher training in technology (CEO Forum 2001). In this regard, the recent reauthorization of the ESEA stipulated that districts that apply for and receive funds through the technology-grant program must use at least 25 percent of the money for professional development unless they can show that they are already providing such services for staff. Yet, some advocates now feel so strongly about the need for technology training that they recommend that schools spend 30 percent of their budget on hardware and 70 percent on training and technology support (Wahl 2000). However, according to a recent survey on technology in the states, only 19 of 26 states indicate that they will spend more on technology training for staff than they did in the previous year (*T.H.E. Journal* 2003). Unfortunately, only 12 states actually require technology training for public school staff (*Education Week* 2003).

As seen in NEA surveys, educators' attitudes about using technology were most highly associated with their level of technology training. Their confidence in their skills and their fondness for technology increased with their usage inside and outside of school, and their perception of the value of technology increased as they saw tangible outcomes in student achievement and improvements in their work. The NEA continues to recognize, as it did in the report of the Special Committee on Telecommunications (NEA 1992), that educators' positive perceptions about technology are vital to the successful implementation of technology in public schools. The NEA continues to advocate for the inclusion of public school staff in decision-making about school technology, which should not merely involve decisions about technology purchases but also decisions about training and professional development opportunities. ***The NEA continues to recommend that local affiliates and members be active participants in this decision-making through collective bargaining to ensure that educators receive the high-quality training needed to integrate technology into their instruction.*** Such involvement will help educators to further develop positive attitudes toward the use and value of technology in teaching and learning.

Issue 4. Technology Usage

Conclusion: Technology Is Not Sufficiently Used for Instruction

Instructional staff in public schools use technology primarily for applications such as word processing rather than for direct instruction of students, and the degree of use in instruction varies widely between demographic groups.

The NEA study found that instructional staff in public schools (i.e., classroom teachers and paraeducators) were using technology primarily for word processing rather than for instruction. The proportion using e-mail to communicate with parents and in using the Internet for collecting and sharing information with colleagues increased considerably. The number of school Web sites that served as a source of information to parents and the public also increased dramatically. Yet, only a few educators had integrated technology into their instruction, and they differed in their methods. Those who varied instructional delivery were more likely to be assigned at the secondary school level or to be working in low-poverty schools. Educators in elementary schools and high-poverty schools were more likely to use technology to reinforce student skills through drill and practice. Also, geographically, staff in the East had the largest increases in training and integrating technology into instruction.

Recommendations and Other Relevant Research

Training teachers to integrate technology into the instructional process should be given a higher mandate in teacher training and professional development programs. Most experts agree that educators need a pervasive understanding of how technology functions as an instructional tool and what the limitations and benefits of use are in the subject areas. Also, training teachers on how to effectively integrate technology into their instruction requires consideration of when and how training opportunities should occur.

Advocates of education technology strongly argue that the development of education technology skills should begin in preservice training programs or graduate schools of education, well before they are actually applied in the classroom. Also, the unique and constantly changing nature of technology requires that teacher skills be continually

updated through ongoing professional development activities. The affiliation of the International Society for Technology in Education (ISTE) with the National Council for Accreditation of Teacher Education (NCATE) has resulted in strong accreditation guidelines for technology in teacher preparation, with all universities seeking accreditation being required to verify their commitment to technology training (ISTE 2002). However, using technology as a teaching tool has only become a part of the teacher preparation curriculum within the past 10 years and has not been required for in-service training until recently. The National Educational Technology (NET) project implemented by ISTE and funded by the U.S Department of Education has developed a set of standards for current teachers, schools, and districts to follow for preparing teachers at all levels of school experience to use technology (ISTE 2002). Several key elements include time for learning technology, flexibility, on-site support, administrative support, and continued professional development.

Unfortunately, only 10 states have had 75 percent or more of their teachers in high-poverty schools participating in professional development within the last year on using computers for direct instruction. Only 8 states have reported that 50 percent or more of their new teachers feel prepared to use computers for instruction their first year (*Education Week* 2003). ***The NEA strongly recommends that state departments of educations begin to adopt the ISTE's NET standards or similar standards for school districts to ensure that all teachers are adequately prepared to use technology as an integral part of their instruction. In addition, the NEA urges educators to recognize professional development in technology as an ongoing process to which they must commit themselves and that the integration of technology into instruction will require fundamental changes in the way teachers and paraeducators do their jobs.***

Issue 5. Demographic Differences

Conclusion: Technology Gaps Remain for Particular Groups of Schools, Teachers, and Students

Substantial gaps in technology access are still evident for particular demographic and geographic groups, such as between high- and low-poverty schools; early, mid-, and late career professionals; elementary, middle, and high schools; and different regions of the country.

The NEA study found that access to the Internet in schools and classrooms increased substantially between 1998 and 2001, but, despite the attention given to closing the "digital divide," disparities are still found between schools based on their poverty level. In addition, educators with the longest tenure in the public schools and those at the higher grade levels have greater access to the Internet and technical resources. Although fewer early career staff have Internet connectivity in their classrooms, those in high-poverty schools and elementary schools are further limited in their access to the Internet because of older and more obsolete computers.

Recommendation A and Other Relevant Research

The upgrading and maintenance of computers with Internet access in high-poverty schools, which are usually schools with majority African American or Hispanic student populations, should be increased to ensure that the digital divide is, indeed, closing for technology access, not just for computer counts.

The E-rate fund has been a tremendous resource for high-poverty schools to purchase technology, and nearly $4 billion was distributed in the first two years of the program despite numerous problems with the application process (Puma, Chaplin, and Pape 2000). These funds have helped to bring high-poverty schools into equality with their low-poverty counterparts, and use of the Internet has increased substantially among African American students to 31 percent in 2002. Just less than one-third of Hispanic students also used the Internet at school in that year. Use of the Internet by students in high-poverty schools grew by 60 percent between 2000 and 2002 to reach a high of 32 percent (Corporation for Public Broadcasting 2003).

Unfortunately, however, most students in high-poverty schools cannot compensate for their inadequate school technology by using the Internet outside of school or at home. According to a recent study on Internet use at home, high-poverty children still have not achieved access at the level that low-poverty students had two years ago. (Corporation for Public Broadcasting 2003). In this regard, experts are now warning that the divide between high-income and low-income children will soon be fueled not so much by mere access to computer hardware but by access to high-quality content from the Internet, which generally requires a high-speed broadband connection, costing five times more than dial-up services.

The NEA recommends that school administrators and education policy makers continue to work toward bring-

ing Internet access to all public school classrooms. In some cases, that may require upgrading hardware and school infrastructure. Ample funds are still available through the E-rate and other private grant sources, so school districts must become more diligent in securing these critical resources. Further, the NEA and state affiliates should take full advantage of partnerships forged with other organizations, public agencies, and state governments to ensure that the digital divide continues to close at a steady pace and that other inequities are not created by the type of digital access found in high-poverty schools.

Recommendation B and Other Relevant Research

Technology in public schools, particularly the Internet, should be more accessible to educators with less job experience and to those in elementary schools to ensure that both young students and newer educators have opportunities to build on skills and cognitive styles already acquired outside of school.

When school districts are planning for the implementation of technology, they usually start with the high schools and work their way down. They believe that older students will make better use of the technology, and that because these students are closer to finishing school, they need to learn the skills before they leave. However, others go even further to debate whether providing young children with computers in school wastes money that could be better spent on reducing class sizes and removing lead paint from poor neighborhoods (Alliance for Childhood 2001). Such critics warn that computers may account for rising health problems, such as eyestrain and obesity in young children, and they strongly criticize the desocializing effects of computers on young children (National Association for the Education of Young Children 1996, 1998; Alliance for Childhood 2001).

However, advocates of technology in schools point out that timing is crucial and that children as young as three and four are ready to use computers in developmentally appropriate ways (Haugland 2000). Although direct links have not been widely established between computers and academic achievement at any school level, a plethora of research shows that young children make improvements in developmental skills such as memory, problem solving, verbal skills, nonverbal skills, manual dexterity, abstraction, self-concept, and motivation (Haugland 1992; Nastasi and Clements 1994). Because these are the most fundamental aspects of child development and the pillars of academic success, it would seem that the research is clear about the value of technology in elementary schools. Critics of technology for young children should remember the "Nintendo Generation," those who were born more than two decades ago and came of age to create the technology revolution that is under way today. ***The NEA recommends that education administrators pay closer attention to the long-term benefits of ensuring adequate technology in the early grades and seek to ensure that elementary schools receive a higher priority in state and district technology planning. It is further recommended that more assistance be provided to elementary schools in finding private and public resources for funding ongoing technology plans.***

Regarding the Nintendo Generation, 16.9 percent of the 3.1 million teachers employed full-time in K–12 public schools in 2000 were under 30 years old (NCES 2001). Although the NEA's study found the gap to be closing for educators in their early careers on their access to computers in the classroom, their classroom access to the Internet and other technologies still lagged behind that of educators with more experience. In contrast, however, early career educators rated their computer skills higher and used the Internet more outside of school. Moreover, fewer early career educators believed that their schools' lack of technology was an obstacle to their job effectiveness. These findings are consistent with other research documenting the frustrations newer educators face on entering their public schools. Other studies have found that newer educators acquire technology skills through their own college training and home use and entered the profession only to find restricted access to technology as well as a lack of technical support (North Central Regional Educational Laboratory 2003). In addition, they also may have felt a lack of support from experienced educators who did not want to learn technology and were critical of such ideas. Consequently, new educators retreated and may even have stopped attempting to use technology at school altogether. They might also have felt overburdened by the workloads and did not have time to develop ways to integrate technology into their work, particularly with the lack of support and resources. In some schools, they may have been feeling the pressure, in addition to carrying out their main responsibilities, of having others rely on them for technical assistance.

Strong advocates of school reform such as Larry Cuban have argued that such conditions account for the fact that much of teachers' use of computers has been at home rather than in the classroom. Cuban (2002) has also argued that these conditions cause new teachers to make fewer subsequent attempts to integrate technology into the instruction,

and thereby to maintain customary teaching practices. Others have argued further that these conditions help account for the ongoing loss of teachers from the profession, particularly of new teachers (Ingersol 2001). ***The NEA recommends that new teachers be encouraged to use their technology skills by ensuring that their access to computers in their classroom continues to grow—especially their full access to the Internet and other education technologies.*** For new educators to use technology effectively, they must be provided with adequate resources to engage their skills continuously and directly in their classrooms.

Issue 6. Perceptions of Technology

Conclusion: Educators' Perceptions of Technology Are Significantly Associated with their Job Experiences

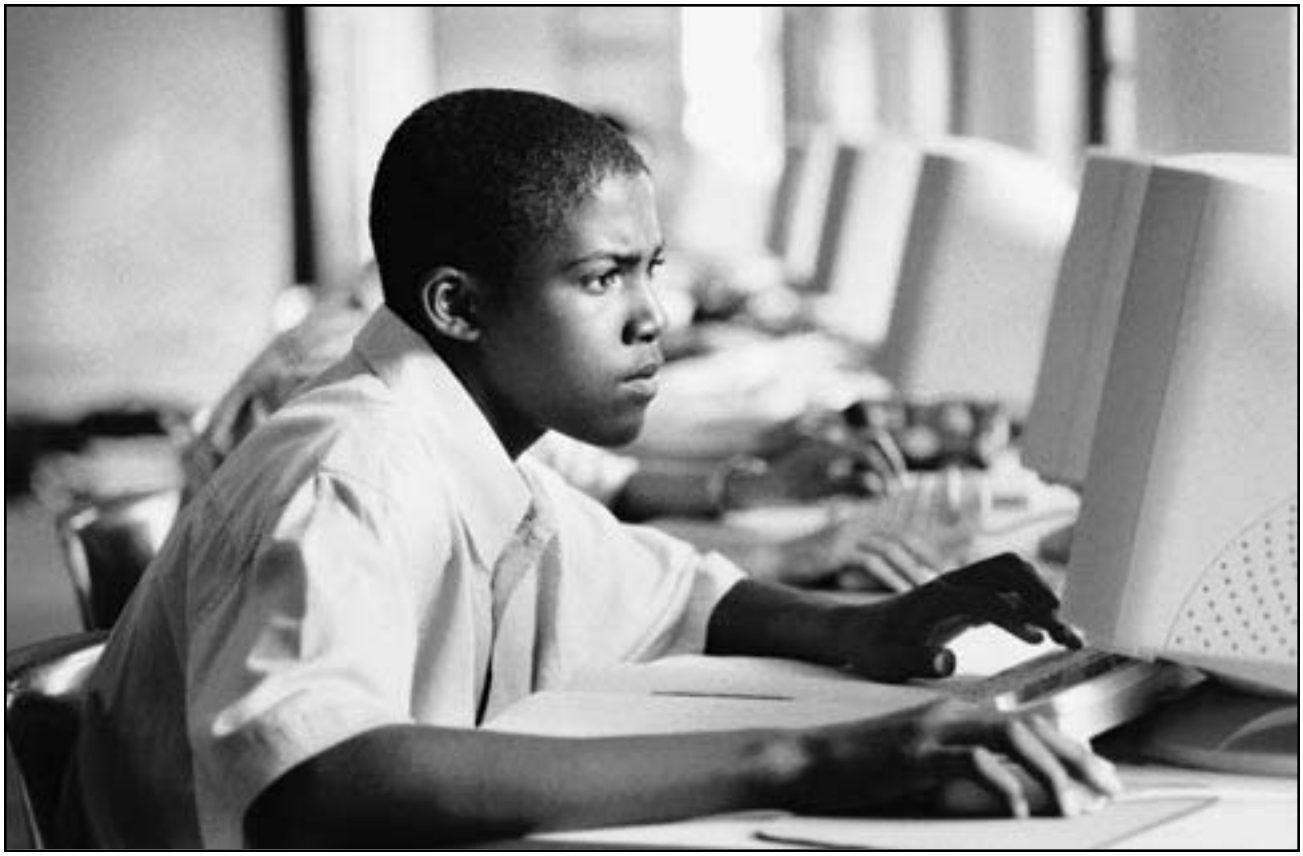
Educators' attitudes toward technology changed over time, and perceptions that were more positive were strongly associated with more complex uses for instruction. The NEA's study found that educators who felt more positively about technology and who were more confident in their technology skills in both 1998 and in 2001 were more familiar with computers and had used technology more to improve their job effectiveness. However, the value that educators ascribed to technology in teaching and learning declined, overall, and their perceptions became more complex over time. Although use of e-mail and the Web continued to support educators' positive perceptions of technology, educators also appeared to expect more. Their expectations included individualizing instruction and integrating technology into instruction, thus going beyond word processing and student drills. Moreover, educators tended to ascribe a higher value to technology if it allowed them to work with more students or if it helped students attain achievement goals and standards. Although educators' perceptions of technology changed in substantive ways over time, their experiences in using technology changed only in tangential ways. This dissonance between expectations and experience may account to some extent for the decline in the value that educators ascribed to technology in teaching and learning.

Recommendations and Other Relevant Research

Federal funding agencies, state education agencies, and school districts need to inspire more research on broad-scale school technology programs—ones that are integrated into instruction and that lead to improved student outcomes. To maximize the effects of technology on student achievement, experts agree that technology must be implemented systematically to allow teachers and students to go beyond conventional content and thereby deepen the process of learning. Experts further agree that increased student learning requires organizational changes such as common planning time and prompt on-site technical support. It requires structural alignments such as coordination of teacher professional development, curricula, and assessment and curriculum standards. Finally, it requires an active commitment to equity (Office of Education Research and Improvement 2002). Thus, if implementation of technology in public schools is to have a significant impact on student learning, an integrated, broad-scale effort will be needed—one designed to bring entire schools or districts into the process.

A number of the innovative technology programs that districts and states are implementing across the country have proved effective in teaching and learning and therefore serve as models. The U.S. Department of Education convened a panel of education experts to identify such exemplary technology programs in schools. These programs vary widely in creativity, content, and technical involvement (Office of Education Research and Improvement 2002). The panel's list of programs may not be exhaustive, but it illustrates how technology can be efficiently and effectively integrated into schools (districtwide and statewide) and thus serve as excellent models for study and emulation.

Beyond the model programs currently operating around the country, the NEA recommends placing further emphasis on research that explores "best practices" to help document direct links between school technology and student achievement. There is much anecdotal evidence that technology helps to improve student test scores, motivation, and attendance and, further, that it enhances professional development for staff and increases parental involvement in education. However, only a systematic and broad-scale effort can establish links between technology and student achievement, and research of this issue will require adequate funding despite dwindling education resources. This nation currently spends more than $300 billion on public K–12 education, but less than 0.1 percent of the money goes to fund research on educational strategies that work (CEO Forum 2001). ***The NEA strongly urges state affiliates to work with legislators and state education agencies to encourage research and development on effective technology programs to help settle the debate on the "value" of technology in education.***



Appendix A: Limitations of the Study

A limitation of the study involves the NEA members who participated in the follow-up survey. Respondents to the follow-up survey were, to some extent, self-selected. The target number for the follow-up sample was 1,000, but it was necessary to initiate contact with all participants in the original survey (N = 3,371) to achieve that target. Although a purely random sample selection of the follow-ups was the initial intent, time constraints were prohibitive. Consequently, additional analyses were conducted to determine the extent to which the members participating in the 2001 follow-up survey were representative of members in the original survey conducted in 1998.

Results revealed only slight differences between the original respondents and follow-up respondents. These were differences that could be expected, to some extent. The most notable differences involved their age and level of experience, most likely caused by retirement attrition. Proportionally, the follow-up group included fewer of the oldest and most experienced members who participated in the initial study. Also, slightly more members in the follow-up study had access to a computer at home during the original study, possibly indicating a higher overall income level. Assuming that the follow-up respondents had a higher income level, it could further be assumed they also had greater residential stability and greater accessibility for the follow-up study. In addition to these demographic differences, slight differences were also found between the follow-up and original respondents on two issues; but, statistically, these were less significant than the two demographic differences noted above. In sum, slightly fewer respondents to the follow-up survey felt that a lack of computer access at school was an obstacle to their job, and slightly more were knowledgeable about connectivity issues in their schools, such as whether there were network and Internet connections in the school. Beyond these differences, the 2001 follow-up respondents were found to be no different from the original respondents in 1998 on all other demographic characteristics, as well as in their initial levels of access, technical support, training, usage, level of impact, and perceptions of education technology.

Appendix B:
Survey Instrument

PS1

TECHNOLOGY ISSUES SURVEY
NEA MEMBERS – TELEPHONE INTERVIEWS

Hello, I'm calling from _____ on behalf of the National Education Association (NEA). May I speak to _____.

Three years ago you participated in a survey for the NEA that gathered information from teachers and other school staff on technology issues in the public schools. We'd like to follow up with you to determine what changes or improvements may have occurred since that time. The survey will take 10–15 minutes, and the questions are similar to those that you answered three years ago. If you have a few moments, the NEA would greatly appreciate your participation.

If respondent does not remember the prior survey, say:
The survey was conducted between January and July of 1998 and you responded by _____(mail/telephone).
(See roster)

To start, I'd like to update your school information.

1. Are you still working in the same school that you worked in three years ago?
[*See roster:* **READ NAME OF SCHOOL]**

[1] Yes **[Go to Q3]**
[2] No

1b. What is the name of your current school and the city and state it is located in?

_____ _____
(Record: Name of School) *(Record: City/State)*

2. At what level is your PRIMARY work assignment? **[Read response choices]**
[Mark ONE Response]
[1] Elementary
[2] Middle school or junior high
[3] Senior high
[4] Combination/Other
[9] [Don't know/Refused]

3. What is your PRIMARY job position? **[Read response choices]**
[Mark ONE Response]
[1] Teacher **[Go to Q5]**
[2] ESP or Classified Employee
[3] Administrator
[4] Other
[9] [Don't know/Refused]

PS2

4. Do you currently have any kind of instructional responsibilities with students?
[1] Yes **[Go to Q7]**
[2] No **[Go to Q7]**
[9] [Don't know/Refused] **[Go to Q7]**

5. Including this year, how many years of full-time teaching experience have you had?
[If '00', Go to Q7]
[ ]
[99] [Don't know/Refused]

6. Including this year, how many years of full-time teaching experience have you had in your present school system?
[ ]
[99] [Don't know/Refused]

Now, I'd like to ask you about the technology in your school and outside of school.

7. Where do you have access to a computer?
[Mark ALL that Apply]
[1] At school
[2] At your home or someone else's home
[3] At a public library or university
[4] No access at all
[9] [Don't know/Refused]

8. How many computers are there in your classroom or primary work area at your school that can be used by your students?
[ ]
[99] [Don't know/Refused]

9. How many computers are in a computer lab at your school that can be used by students?
[ ]
[99] [Don't know/Refused]

Indicate where you have PRIMARY access to each of these technologies.
[Read the response choices along with each item]

1 = In the classroom or work area where you spend the most time
2 = In a computer lab
3 = In school but not in your classroom or work area (for example, an office or staff lounge)
4 = No access at school

PS3

[Mark ONE Response]

10.	A television	❑1	❑2	❑3	❑4	DK/Refused	❑9
11.	A VCR	❑1	❑2	❑3	❑4	DK/Refused	❑9
12.	Cable TV	❑1	❑2	❑3	❑4	DK/Refused	❑9
13.	Computers for student use	❑1	❑2	❑3	❑4	DK/Refused	❑9
14.	Internet, World Wide Web, and e-mail	❑1	❑2	❑3	❑4	DK/Refused	❑9
15.	On-line computer networks (such as CompuServ, Prodigy, America Online)	❑1	❑2	❑3	❑4	DK/Refused	❑9

Ask Q16 – Q21 Only If Q3 or Q4 Equals '1'

Indicate where you have used or done the following:

[Read the response choices along with each item]

1 = At school and outside of school
2 = At school only
3 = Outside of school only
4 = Haven't used or done

16.	Word processing software for instructional purposes	❑1	❑2	❑3	❑4	DK/Refused	❑9
17.	Hypermedia or multimedia software for instructional purposes	❑1	❑2	❑3	❑4	DK/Refused	❑9
18.	CD-ROMS for instructional purposes	❑1	❑2	❑3	❑4	DK/Refused	❑9
19.	Instructional laser discs or videodiscs for instructional purposes	❑1	❑2	❑3	❑4	DK/Refused	❑9
20.	Exchanged instructional information with a teacher at another school via computer	❑1	2❑	❑3	❑4	DK/Refused	❑9
21.	Engaged with any of your students in on-line collaborative teaching or distance learning	❑1	2❑	❑3	❑4	DK/Refused	❑9

[Read the response choices along with each item]

1 = Yes
2 = No
3 = Not Sure

22.	Have you visited the NEA World Wide Web site (www.nea.org)?	❑1	❑2	❑3	Refused	❑9
23.	Have you ever communicated by e-mail?	❑1	❑2	❑3	Refused	❑9
24.	Have you ever communicated with parents by e-mail?	❑1	❑2	❑3	Refused	❑9
25.	Does your school have a home page on the World Wide Web?	❑1	❑2	❑3	Refused	❑9

PS4

26.	Are classroom or lab computers connected to the Internet?	❑1	❑2	❑3	Refused	❑9
27.	Are teachers or ESP staff at your school involved in decisions about future plans for buying new software?	❑1	❑2	❑3	Refused	❑9
28.	Are teachers or ESP staff at your school involved in decisions about future plans for buying new computers and other new technologies?	❑1	❑2	❑3	Refused	❑9
29.	Does your school district provide low-interest or interest-free loans to teachers to purchase computers?	❑1	❑2	❑3	Refused	❑9

Indicate how often you do any of the following either from school or outside of school.

[Read each response choice along with each item]

1 = Not at all
2 = Less than one hour a week
3 = 1–10 hours a week
4 = More than 10 hours a week

		From School					Outside of School					
30.	Send/read e-mail	❑1	❑2	❑3	❑4	DK/Refused ❑9	❑1	❑2	❑3	❑4	DK/Refused	❑9
31.	Surf the Web	❑1	❑2	❑3	❑4	DK/Refused ❑9	❑1	❑2	❑3	❑4	DK/Refused	❑9
32.	Share teaching ideas with other teachers using computer technology	❑1	❑2	❑3	❑4	DK/Refused ❑9	❑1	❑2	❑3	❑4	DK/Refused	❑9

Ask Q33 – Q39 Only If Q3 or Q4 Equals '1'

How much has computer technology improved your effectiveness in the following areas?

[Read each response choice along with each item]

1 = Very much
2 = Somewhat
3 = Not too much
4 = Not at all

33.	Word processing of tests, handouts, and other written materials	❑1	❑2	❑3	❑4	DK/Refused ❑9
34.	Individualizing instruction	❑1	❑2	❑3	❑4	DK/Refused ❑9
35.	Working with more students	❑1	❑2	❑3	❑4	DK/Refused ❑9
36.	Reinforcing skills through drill and practice	❑1	❑2	❑3	❑4	DK/Refused ❑9
37.	Accessing new information through the Internet and World Wide Web	❑1	❑2	❑3	❑4	DK/Refused ❑9
38.	Varying instructional delivery by using multi-media or other technologies	❑1	❑2	❑3	❑4	DK/Refused ❑9
39.	Helping students attain goals and meet standards	❑1	❑2	❑3	❑4	DK/Refused ❑9

PS5

Rate the adequacy of the following equipment and services associated with technology in your school.

[Read each response choice along with each item]

1 = More than adequate
2 = Adequate
3 = Inadequate

40.	Capacity of computers	❑1	❑2	❑3	DK/Refused	❑9
41.	Training on existing equipment and software	❑1	❑2	❑3	DK/Refused	❑9
42.	Technical support for equipment and software	❑1	❑2	❑3	DK/Refused	❑9
43.	Training on how to integrate technology into the instructional process	❑1	❑2	❑3	DK/Refused	❑9
44.	Training on how to access on-line services	❑1	❑2	❑3	DK/Refused	❑9
45.	Maintenance of computer, television, and video equipment	❑1	❑2	❑3	DK/Refused	❑9
46.	Software programs for teachers (such as word processing, graphics, and programs to calculate grades)	❑1	❑2	❑3	DK/Refused	❑9
47.	Software programs for students (such as word processing, graphics, remedial packages, individualized instruction, and games)	❑1	❑2	❑3	DK/Refused	❑9

How much of an obstacle is each of the following to your own effectiveness in your job?

[Read each response choice along with each item]

1 = Very much of an obstacle
2 = Somewhat of an obstacle
3 = Not too much of an obstacle
4 = No obstacle

48.	Lack of access to computers, software, and technology	❑1	❑2	❑3	❑4	DK/Refused	❑9
49.	Lack of funds for computers, software, and technology	❑1	❑2	❑3	❑4	DK/Refused	❑9
50.	Lack of technical support to maintain existing equipment	❑1	❑2	❑3	❑4	DK/Refused	❑9
51.	Lack of time to learn about new technology	❑1	❑2	❑3	❑4	DK/Refused	❑9
52.	Old or obsolete equipment	❑1	❑2	❑3	❑4	DK/Refused	❑9
53.	Unfamiliarity with computers or lack of computer training	❑1	❑2	❑3	❑4	DK/Refused	❑9
54.	Lack of good computer software for instructional use	❑1	❑2	❑3	❑4	DK/Refused	❑9

PS6

To what extent do you believe your local or state Association should have a role in the following:

[Read each response choice along with each item]

1 = Definitely should have a role
2 = Probably should have a role
3 = Probably should NOT have a role
4 = Definitely should NOT have a role

55.	Providing technology training for members	❑1	❑2	❑3	❑4	DK/Refused	❑9
56.	Providing education-related technology training for parents	❑1	❑2	❑3	❑4	DK/Refused	❑9
57.	Working to develop communication opportunities between teachers and parents using technology such as e-mail	❑1	❑2	❑3	❑4	DK/Refused	❑9

To what extent do you support or oppose the following?

[Read each response choice along with each item]

1 = Strongly support
2 = Support somewhat
3 = Oppose somewhat
4 = Strongly oppose

58.	Having your state and local associations communicate with you and other members by e-mail	❑1	❑2	❑3	❑4	DK/Refused	❑9
59.	Having your state and local association publications available on-line, as well as through the mail	❑1	❑2	❑3	❑4	DK/Refused	❑9

60. Compared with other staff in your school, how would you rate your own computer skills?

[1] Excellent
[2] Good
[3] Not so good
[4] Poor
[9] DK/Refused

61. How do you feel about computers and technology… do you like them, dislike them, or do you have mixed feelings about them?

[1] Like
[2] Dislike
[3] Mixed feelings
[9] DK/Refused

62. How important is technology in teaching and learning?

[1] Essential
[2] Important but not essential
[3] Not important
[9] DK/Refused

PS7

Rate each of the following at the school where you now work.

[Read each response choice along with each item]

1 = Excellent
2 = Good
3 = Not so good
4 = Poor

63.	Resources for classroom instruction	❑1	❑2	❑3	❑4	DK/Refused	❑9
64.	Your students' interest in learning	❑1	❑2	❑3	❑4	DK/Refused	❑9
65.	The condition of your school building	❑1	❑2	❑3	❑4	DK/Refused	❑9

Now, I'd like to update your demographic information.

66. What is your highest educational level?
[1] Less than a Bachelor's
[2] Bachelor's
[3] Bachelor's plus
[4] Master's
[5] Master's plus
[6] Doctorate
[9] [Don't know/Refused]

67. What is your age?

[ ]

[9] [Refused]

68. Are you a member of NEA?
[1] Yes
[2] No
[3] Not sure
[9] [Refused]

[Record the respondent's SURVEY ID NUMBER] _____
(See roster)

This concludes the survey, and thank you very much for taking the time to participate in this survey again.

Appendix C: Standardized Regression Coefficients

Table C1. Standardized Regression (β) Coefficients between Technology Experiences and Attitudes Toward Technology

	Rating of own computer skills		Fondness for computers		Value of technology in teaching and learning	
Technology experiences	**1998**	**2001**	**1998**	**2001**	**1998**	**2001**
IMPLEMENTATION OF TECHNOLOGY						
Unfamiliarity with computers or lack of training is obstacle	–.415***	–.314***	–.199***	–.126*	—	—
Software programs for students is adequate	.137**	.104*	.195**	—	—	—
Software programs for teachers is adequate	—	—	—	—	—	–.146**
Teachers and ESPs involved in decisions to purchase new technology	—	—	—	—	—	—
Maintenance of computers and other equipment is adequate	—	—	—	.124*	—	—
Lack of access to computers is obstacle	—	—	.162**	—	—	—
Lack of funds for computers, software, and other technology is obstacle	—	—	—	.129*	—	—
Classroom/lab computers connected to Internet	—	—	–.204***	—	—	–.097*
School has home page on the World Wide Web	—	—	.174***	—	—	—
COMMUNICATIONS/INFORMATION SHARING						
Communicated via e-mail	.159***	—	—	—	—	—
Send/read e-mail outside of school	—	.183***	—	.149*	—	—
Communicate with parents via e-mail	—	.098*	—	—	—	—
Share teaching ideas with other teachers using computer technology outside of school	.102*	—	—	.123*	—	—
Surf the Internet at school	—	.126**	—	—	—	—
Support state/local Assoc. communicating via e-mail	—	—	.105*	—	.106*	—
IMPACT ON TEACHING EFFECTIVENESS (INSTRUCTIONAL STAFF ONLY)						
Accessing new info via the Internet improved	—	.109*	.172**	.111*	.162**	—
Working with more students improved	.139**	.097*	—	.117*	.143*	—
Word processing of tests, handouts, and other written materials improved	.161***	—	.133**	—	.109*	—
Reinforcing skills through drill/practice improved	—	—	—	—	.157**	—
Individualizing instruction improved	—	—	—	—	—	.163**
Helping students attain goals/standards improved	—	—	—	—	—	.139*
Adjusted R^2	**.454**	**.330**	**.235**	**.115**	**.121**	**.072**

*$p < .05$; **$p < .01$; ***$p < .001$ — = data not reported because nonsignificant.

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1201 16th St., N.W. | Washington, D.C. 20036-3290
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