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ABSTRACT

A state-by-state survey of technology in the schools was conducted during the spring of 1998. Responses were received from district technology coordinators in more than 1,990 school districts out of approximately 3,668 that were sent surveys in the following 21 states that achieved response rates of at least 40% of their districts: Alaska, Arkansas, Delaware, Florida, Hawaii, Indiana, Kansas, Kentucky, Louisiana, Maryland, Minnesota, Mississippi, Missouri, North Carolina, Oklahoma, Pennsylvania, South Carolina, Utah, Washington, West Virginia, and Wyoming. This report compares districts from individual states to an aggregation of all responding districts from these states. A framework was developed with a set of indicators for policymakers to consider when assessing whether or not schools have established the essential conditions necessary to begin improving student learning through technology. The following seven dimensions included in the framework are interdependent components of a system: learners; learning environments; professional competency; system capacity; community connections; technology capacity; and accountability. Results are organized according to these seven dimensions. Data are presented in 35 tables, and relationships among the variables are discussed. The questionnaire is appended. (AEF)

Milken Family Foundation

Progress of Technology in the Schools: Report on 21 States

Lewis C. Solmon

Alaska
Arkansas
Delaware
Florida
Hawaii
Indiana
Kansas
Kentucky
Louisiana
Maryland
Minnesota
Mississippi
Missouri
North Carolina
Oklahoma
Pennsylvania
South Carolina
Utah
Washington
West Virginia
Wyoming

Milken Exchange on education technology

The Milken Exchange on Education Technology was launched as a way of formalizing and extending the Milken Family Foundation's years of effort to accelerate the responsible integration of learning technology into education. We are dedicated to working with others to create a national agenda that, as one of its goals, seeks to close the opportunity divide in this country so that no child lacks the skills necessary for success in the digital age.

The Challenge confronting us is not whether technology has a role in today's classrooms, but rather how to put into place the essential conditions that will make these tools truly effective in improving student performance.

For it is our experience and belief that technology—properly managed and applied—has the potential to restore rigor to children's learning, to rebuild public confidence in American education, and to help ensure that the equality of opportunity in which we pride ourselves as a nation has meaning.

The Milken Exchange will advance a compelling national agenda for education technology through five key strategies:

- ***Increasing Public Awareness***
- ***Advancing Public Policy***
- ***Supporting New Designs for Teaching and Learning***
- ***Building Capacity of Schools through Planning***
- ***Reflecting and Acting on Research and Practice***

in support of educators working to advance the accomplishments and achievements of children and youth.

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PROGRESS OF TECHNOLOGY IN THE SCHOOLS: REPORT ON 21 STATES

Executive Summary

Lewis C. Solmon, Senior Vice President and Senior Scholar
Milken Family Foundation

It is very important that policymakers seeking to develop and implement school technology know what has already been accomplished and what still needs to be done. Information is required at the school, district, and state level, but unfortunately the necessary data either do not exist or are incomplete, inaccurate, untimely, or not consistent over time and across states.

High quality data that are comparable from state to state will themselves stimulate progress in properly implementing and utilizing technology in America's classrooms. States that are shown to have made the most progress will strive to maintain their high rankings. States at the bottom will be able to use that fact to argue for policies that improve state education technology standards.

While measures to assess a student's technological fluency are not yet developed, it is no longer enough for educators to simply report to policymakers that the public investment in learning technology resulted in a better student-to-computer ratio or an increase in the number of classrooms wired. Policymakers want more than anecdotes; they need evidence that their districts and states are making progress in advancing technology in their schools. We have developed a framework to provide that. It is a set of indicators for policymakers to consider when assessing whether or not schools have established the "essential conditions" necessary to begin improving student learning through technology. The seven dimensions included in the framework are interdependent components of a system: Learners, Learning Environments, Professional Competency, System Capacity, Community Connections [formerly External Support], Technology Capacity, and Accountability.

In response to the lack of accurate and current state-by-state data on school technology, the Milken Exchange on Education Technology undertook a state-by-state survey of technology in the schools during the spring of 1998. Those responsible for school technology at the state level also felt that assessments of the status of technology were tied too much to measures of equipment, and did not consider other aspects of technology planning and advancement. Thus, questions were designed to fit into what at the time of the survey were the six dimensions for gauging progress of technology in the schools developed by the Milken Exchange[1]. These dimensions have been expanded to add "Accountability" since the survey was conducted.

[1] Lemke, Cheryl and Edward C. Coughlin. *Technology in American Schools: Seven Dimensions for Gauging Progress.* Santa Monica, CA: Milken Family Foundation, 1998.

The Milken Exchange worked with state education technology directors who distributed the questionnaires to the technology coordinators (or similar individuals) in districts in their respective states and followed up to try to maximize the response rates. Twenty-eight states participated in the survey, and 21 of these achieved response rates of at least 40% of their districts. Although there were a number of reasons for non-participation, the most frequent one was timing of the Milken Exchange survey vis-à-vis other data collection activities in the state.

We have responses from over 1,990 districts out of approximately 3,668 that were sent surveys in the 21 participating states, and the state technology coordinators in each of the 21 states indicated that the respondents comprised a representative sample for their states. This report compares districts from individual states to an aggregation of all responding districts from the 21 states that achieved at least a 40 percent response rate. The overall response rate in the 21 states was 54.3%. The caution that we are not talking about a representative national sample must be kept in mind.

We present two different types of information in this report, both of which should be helpful for policy and planning in the states. First, there are many tables that simply describe the presence or absence of certain factors or conditions, or the magnitude, frequency, or intensity of various factors. Such measures establish baseline levels for each variable for each state in this, our first report. States need to know where they are now in order to get where they want to be in the future. In subsequent years, there should be substantial interest in changes (growth or decline) in these factors as states progress with their technology initiatives at different rates. These baseline data can serve other more proximate purposes as well. The tables present data on each state separately as well as combined data for all districts that responded from all states. An individual state can compare its own data to the overall statistics and to data from any other states it considers relevant in order to see how it ranks. Although the overall figure is not necessarily the ideal, policymakers may be stimulated to act if they see their state lagging in regard to factors they see as important. And where a state is ahead of others, it may strive to keep its advantage.

The second type of information in this report is evidence on relationships among the variables that we measure. The ultimate goal of research on education technology is to identify the existence and magnitude of its impact on student learning, attitudes, and behaviors. Thus, using cross-sectional data by district we attempt to identify factors related to changes in students. Also, we believe that teacher attitudes could be significant in determining how technology impacts students, so we try to identify correlates with positive teacher attitudes about technology.

The following are some highlights from the study:

- Although many states and districts are making progress in implementing their technology plans, none are far enough along yet to expect to see major changes in student achievement due to effective use of technology.

- Overall, District Technology Coordinators (DTCs) representing 68% of students say teachers in their districts view technology as a powerful tool for helping them improve student learning, rather than just another fad being mandated by those above them.

- On average, teachers received 12.8 hours of training in technology use last year. Those with more training were more skilled in using technology. Teachers in districts representing 53% of students received some type of incentives to get technology training, most frequently participation in special workshops, additional resources for their classrooms, or release time.

- DTCs representing 64% of students say their teachers enhance their curricula by integrating technology-based software into the teaching and learning process. The more teachers use technology in various ways in the classroom, the more they recognize it as a powerful tool. Classroom use is the most important way for teachers to become convinced of technology's value. Differences in the extent to which teachers in various districts use technology in the classroom can explain 18.3% of the differences in teacher attitudes toward technology in different districts. Those who make better use of it recognize its power more. Those who use it less are more likely to feel technology is just another fad being mandated from above.

- We also tried to explain teacher attitudes toward technology by total hours of technology training, the availability of incentives to get training, the cost per student per year of the district's technology plan and percent of the district plan that has been funded. These, along with the extent to which teachers use technology in their own practice, as distinguished from classroom use, explained less of the attitudinal differences–13.8% to be precise–than what was explained by measures of the use of technology in the classroom. Clearly, when teachers use technology in the classroom they develop more positive attitudes about it, and such use is the most important way to prove its value to teachers.

- Teachers used technology less frequently in their own practice outside the classroom than in classrooms. DTCs representing 38% of students reported that their teachers use it for administrative or classroom management tasks; 31% to communicate with colleagues. Fewer used it to get training or to contact experts.

- Approximately 15% of classroom time is spent using computers or Internet technology. According to DTCs, 56% of their students frequently use computers in at least some of their regular classrooms, 54% of students frequently become independent learners because of technology, 48% of students develop on-line research expertise, and 44% of students interact/communicate more widely.

- DTCs reported that 61% of their students become more engaged learners due to technology, 46% of their students gain a deepened understanding of academic subjects, and 28% get better grades or test scores.

- One of the most valuable results of our survey was the identification of correlates of desired student outcomes. We were able to explain between 10% and 31% of the district-by-district variance in the frequency of occurrence of the outcomes, depending upon which outcome we look at. The measures of progress being made by school districts vis-à-vis technology are better able to explain more proximate student outcomes, such as engagement in learning and student understanding of academic subjects, than outcomes that are further from actual classroom experiences, like grades, test scores, attendance, or dropping out.

- Our study found that where DTCs indicated teachers had more technology training, where there were incentives for teachers to get more of such training, and where teachers had higher technology skills, and where students are reported to be using technology in at least some of their regular classrooms, have become more independent learners, and have developed on-line research expertise, and where teachers are reported to be providing inquiry-based learning projects, to be doing more individualized instruction, and to be integrating technology-based software into the teaching and learning process, they also indicated students were more engaged in learning due to technology and that student understanding of academic subjects has deepened due to technology in the classroom.

- There is a significant and positive relationship between percent of classroom time spent using computers and technology being used in assessment (i.e., when students have to know how to use it to be assessed) and both student engagement in learning and their deepening understanding of academic subjects. However, richer technology plans and more "stuff" do not seem to affect student outcomes.

- Different and wider student interaction with the help of technology appears to enhance engagement but not understanding of academic subjects. On the other hand, more mundane uses of technology, like drill and practice, or the enticement for students to do more homework, while not necessarily engaging, do help deepen understanding of academic subjects.

- Almost all districts have formal technology plans, which on average cover 4.1 years. Cost of these plans range from $53 per student per year in Hawaii to $227 in Delaware. On average, districts have funded 44% of the cost of their plans.

- Technology is funded primarily by state and local public funds, with some help from federal programs, parents, and school fundraisers. Little private money has been forthcoming. Roughly, 23% of districts have benefited from TLCF funds and 36% from other federal funds they used for technology. Districts expect E-Rate funds to cover 13% of their budgets.

- The student to computer ratio varies depending upon how that is defined. We consider all computers capable of accessing the Internet available for student use in classrooms, labs, or library media centers. The overall ratio is 36:1 with substantial variation among states. Our ratio is larger than others are because we restrict computers to those available for student use and to those that can access the Internet.

- About 6% of computers in schools are not used, mostly because they are outdated, but often also because teachers are not trained to use them.

- Districts representing 21% of students indicated that they frequently use technology in student assessment efforts.

- Almost all districts formally track what technology is available at their schools and where it is located. Three-quarters track teacher training. Only half track how teachers and students use the technology.

- The most frequently reported progress indicators are the number of classrooms wired, anecdotes about how teachers and students are using technology effectively, the student/computer ratio, and increased administrative efficiencies.

- Support for technology (in the sense of advocacy) is highest from superintendents, students, school boards, and principals, and lowest from community groups, foundations, local post-secondary institutions and teacher associations. There is a very strong relationship between support for technology from district superintendents and teachers (and a slightly less strong one for principals) and making progress with a district's technology plan.

- There is little school-community communication using technology, with DTCs representing only 19% of students indicating that parents and teachers can communicate via email frequently.

Districts around the country clearly have made some progress toward fully implementing technology in their schools. In subsequent years, follow-up reports will enable those interested in school technology to see what additional advances have been achieved.

Finally, our analyses underline the value of the Milken Exchange's "Seven Dimensions" framework for understanding the dynamics and progress of technology in America's schools. We have seen how the learning environment impacts student outcomes. It is clear that support from district leadership is vital for progress to be made in implementing school technology. We have confirmed the importance of teacher professional development in providing them the skills necessary to succeed in using modern technology.

All of this depends upon the quality of the information available from which we can understand the state of technology in America's schools today. This study has demonstrated the difficulty in obtaining high quality data, for example the different conclusions that can be drawn depending upon one's definition and measurement of the student/computer ratio. But we are left optimistic about what we know, about where we are, and about the good things that will happen to students when we get where we want to be.

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Progress of Technology in the Schools: Report on 21 States

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December 1998

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Hollis Harman and Judith Wiederhorn made this project work by convincing states to participate, supervising the data collection, organizing the production of the report and providing both editorial and substantive input. Tamara Schiff helped design the survey, suggested and ran the analysis, and helped me interpret them. Useful comments were provided by Tom Boysen, Cheryl Lemke, and Ed Coughlin.

Special thanks are due to the 28 state technology directors (STDs) who agreed to participate in this project and to prod their many district technology coordinators (DTCs) into responding to our survey. The State Technology Directors at the time were Della Matthis (AK), Jim Boardman (AR), Alex Belous (AZ), Carol Rocque (CT), Theresa Kough (DE), Peter Lenkway (FL), Diana Oshiro(HI), Phyllis Usher (IN), Sal Tayani (KS), Don Coffman(KY), David Couch (KY), Carol Whelan (LA), Gregory Nadeau (MA), Barbara Reeves (MD), Linda Lord (ME), Mark Manning (MN), Susan Cole (MO), Helen Soule (MS), Elsie Brumback (NC), Steven Sanchez (NM), Tim Best (OH), Phil Applegate (OK), John Bailey (PA), Linda Bartone (SC), Vicky Dahn (UT), James Calleran (VA), Cathy Parise (WA), Brenda Williams (WV), Linda Carter (WY). In addition, without the cooperation of the 2300 plus DTCs there would be no report.

Ana Kosuta in the production department of the Milken Family Foundation produced this report.

Lewis C. Solmon

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HIGHLIGHTS

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INTRODUCTION

The Milken Exchange on Education Technology is seeking to advance innovative and effective uses of learning technology in elementary and secondary schools across the nation. American education is at a crossroads. A 19th-century education system cannot adequately prepare students to live, learn and work in a global, digital age. National polls by the Milken Exchange indicate that business leaders, policymakers and voters all agree about the need for technology in America's schools. The question is what is the best way to get there? What will it take to transition schools into education systems that effectively use technology to improve student learning?

The Exchange employs five strategies in pursuing its goal: increasing public awareness; advancing public policy; supporting new designs for teaching and learning; promoting continuous improvement through planning; and, informing practice through research. These strategies support educators, legislators, state agencies and communities in using technology to transform their school into vibrant, learning environments. The Milken Exchange provides information and insights into emerging issues, policy models, professional development strategies, tools for gauging progress and public opinion research.

It is very important that policymakers seeking to develop and implement school technology know what has already been accomplished and what still needs to be done. Information is required at the school, district, and state level, but unfortunately the necessary data either do not exist or are incomplete, inaccurate, untimely, or not consistent over time and across states. This is made clear by our discussion below of state differences in the student to computer ratio, which is probably the most frequently used indicator of progress schools are making regarding technology. It is also a measure whose meaning varies greatly depending upon what computers are included (i.e., the Apple IIes that are locked in the closet).

In our survey, we asked for the "number of students to each Internet capable computer available for student use." When we compare the student/computer ratios weighted for each state from our survey (presented later in Table 19) with data compiled by the private firm, Market Data Retrieval (MDR), the results are very different. MDR's student/computer ratio (unweighted) includes all instructional multimedia computers located anywhere in the school. But, these may or may not allow students to access the Internet. The MDR definition appears to include the computer on the teacher's desk if it is used for instruction even if students are not allowed to touch it. In theory, the MDR ratio could be very low—and thereby make a state look good—even though no student had access to the Internet, or was even using a computer at all. There is no systematic relationship between the Milken Exchange ratio and the one prepared by MDR. Despite these caveats, *Education Week* decided to use the MDR data in their publication, *Technology Counts '98*. This will transform the MDR data into *facts* that will be quoted over and over despite their limitations. The MDR data sends the wrong message to those making policy, namely, that districts are better off than they actually are.

High quality data that are comparable from state to state will themselves stimulate progress in getting technology into the schools and having it used properly. States that are shown to have made the most progress will strive to maintain their high rankings. States at the bottom will be able to use that fact to argue for more funding—as was done by the state superintendent of schools in California during the deliberations of her California Education Technology Task Force in 1996.

While measures to assess a student's technological fluency are not yet developed, it is no longer enough for educators to simply report to policymakers that the public investment in learning technology resulted in a better student-to-computer ratio or an increase in the number of classrooms wired. Policymakers want more than anecdotes; they need evidence that their districts and states are making progress in advancing technology in their schools. We have developed a framework to provide that. It is a set of indicators for policymakers to consider when assessing whether or not schools have established the "essential conditions" necessary to begin improving student learning through technology. The seven dimensions included in the framework are interdependent components of a system.

1. Learners
2. Learning Environments
3. Professional Competency
4. System Capacity
5. Community Connections [formerly external support]
6. Technology Capacity, and
7. Accountability

In response to the lack of accurate and current state-by-state data on school technology, the Milken Exchange on Education Technology undertook a state-by-state survey of technology in the schools during the spring of 1998 (see Appendix A). Those responsible for school technology at the state level also felt that assessments of the status of technology were tied too much to measures of equipment, and did not consider other aspects of technology planning and advancement. Thus, questions were designed to fit into what at the time of the survey were the six dimensions for gauging progress of technology in the schools developed by the Milken Exchange[1]. These dimensions have been expanded to add "Accountability" since the survey was conducted. Since each dimension was covered by only a very few survey items, none of the dimensions are measured in great depth. Nevertheless, the results do, in our view, give a sense of the progress of technology in each state, and enable us to identify relationships among various measures of the state of school technology.

The Milken Exchange worked with state education technology directors who distributed the questionnaires to the technology coordinators (or similar individuals) in districts in their respective states and followed up to try to maximize the response rates. Twenty-eight states participated in the survey, and 21 of these achieved response rates of at least 40% of their districts. Although there were a number of reasons for non-participation, the most frequent one was timing of the Milken Exchange survey vis-à-vis other data collection activities in the state.

We asked the state technology coordinators in each of the 21 states with at least 40% response rates to look at the list of responding districts and give us their judgments as to whether the responding districts comprised a representative sample for their states[2]. Their affirmative responses led us to publish data on the 21 states listed in Table 1.

[1] Lemke, Cheryl and Edward C. Coughlin. *Technology in American Schools: Seven Dimensions for Gauging Progress.* Santa Monica, CA: Milken Family Foundation, 1998.
[2] We hoped to obtain responses from districts representing different levels of demographics: SES and income, racial composition, location (urban, rural, suburban), and size.

Table 1

Response Rates

	Total number of students that were in districts that responded to Exchange survey: 1997-98	NCES # of students, fall 1996*	% of our students to NCES	District response rate
Hawaii**	190,000	187,653	101%	100%
Utah	472,712	481,812	98%	88%
South Carolina	607,065	653,011	93%	92%
Delaware	98,685	110,549	89%	73%
Pennsylvania	1,514,586	1,804,256	84%	62%
Alaska	103,156	129,919	79%	60%
Wyoming	76,048	99,058	77%	77%
West Virgina	216,885	304,052	71%	69%
Washington	644,901	974,504	66%	51%
Mississippi	331,015	503,967	66%	62%
Arkansas	259,191	457,349	57%	50%
Kentucky	357,208	656,089	54%	70%
Florida	1,205,150	2,2[illegible]2,212	54%	40%
Kansas	247,846	466,293	53%	48%
Oklahoma	329,898	620,695	53%	41%
Louisiana	416,416	793,296	52%	54%
Indiana	510,077	983,415	52%	53%
North Carolina	596,532	1,210,108	49%	55%
Minnesota	399,266	847,204	47%	43%
Maryland	334,095	818,583	41%	58%
Missouri***	58,934	900,042	7%	74%
Overall	8,969,666	15,244,067	59%	54%

* U.S. Department of Education, National Center for Education Statistics. Digest of Education Statistics, 1997. Washington, DC: 1997.

** Hawaii has only one district.

*** Missouri's data are based on a representative sample of districts.

Rank order correlation=.788 (Does not include Hawaii and Missouri)

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Table 1 also indicates the approximate share of students in each state represented in the districts that responded to our survey. In all but six of the 21 states, the share of students was greater than the share of districts, which means that on average relatively large districts in most states responded. We received responses from 54% of the districts in our 21 states, and these contained 59% of the students in those states. The correlation among the states in terms of the percent of districts responding and the percent of students in responding districts was .787, indicating that states with high response rates from districts also had high shares of their students represented[3].

We relied on our consultations with the state technology directors to confirm the representativeness of data from individual states. In order to measure more precisely the representativeness of districts within each state, we would need to determine the demographic characteristics (size, urban-rural, income level, ethnicity) of responding districts and see whether or not these are in proportion to their actual representation in the state. For this report, we looked only at the size of districts represented, and that helped to confirm the representativeness of responding districts[4].

How accurately our results represent actual conditions in a state depends upon the accuracy of the data we received. The results that follow are responses of district technology coordinators (DTCs) to questions about their districts, and about the schools, teachers, and students located in their districts. Some of the questions require "factual" answers, while others may require opinions or judgments from the DTCs. Obviously, the knowledge and experience of district technology coordinators could vary greatly from district to district. Some DTCs have long histories of involvement with technology, while others may be new to the field. Some DTCs may spend a great deal of time in the schools, while others do not. Some districts require schools to report on various aspects of their technology situation, while other districts have little formal data upon which to base their answers. Hence, there inevitably will be some variance in the "quality of reporting" among DTCs. This could be a problem in large urban districts in particular. Nevertheless, the district technology coordinators usually are in a very good position to observe, gather data from, and form opinions on the state of technology in the schools in their districts. In some cases, their reporting may obtain more accurate information than would be obtained directly. For example, advanced technology-using teachers may judge themselves as novices because they know how much they still have to learn, whereas beginners may feel they are advanced because they have made great progress in their own minds. DTCs are likely to provide more realistic evaluations of teacher competencies in these cases, even compared to teacher self assessments.

Implicitly, we are assuming that the DTCs are capable of answering the questions posed in a relatively accurate and unbiased fashion. The consistency of responses to similar questions asked in different ways gives us confidence that this assumption is correct[5]. Later in this report we shall present results indicating that most districts track multiple progress indicators about which our survey inquires. Again this gives us confidence that DTCs have a great deal of information on technology in the districts.

We are seeking information that ideally would be provided by districts themselves, schools, teachers, and students, depending on the question asked. However, all of the data we get is from people at the district level. In the first case, the district, there is a single piece of information required. For example, the district either has a technology plan or it does not, and that plan costs a certain amount to implement. Obviously, DTCs can provide reliable data on district measures. But a district may have as

[3] Hawaii and Missouri are excluded from the correlation.
[4] There could be a tendency for districts with a relatively high interest in technology to be the most likely to respond. Since responding districts appear to be further along regarding technology than the conventional wisdom suggests, perhaps our sample may be biased toward more advanced districts.
[5] For example, we calculated the cost of each district's technology plan per student per year based on data provided on total cost, length of plan, and number of students. We then calculated a ratio of the weighted average of that number divided by total per student current expenditures in the state. We compared the resultant overall figure of 3.14% to the overall response to the question of what percent of your operating budget goes toward technology, which was 3.4%. Given the various outside sources of data used in the calculations, these numbers are very close.

many as 600 separate schools, and in them thousands of teachers and tens of thousands of students. Situations may be different for various schools (student to computer ratio), teachers (amounts of technology training received and how they use technology in their classrooms if at all), and students (competency in using technology). In some districts, a single response provided by a district technology coordinator may apply to all or most schools, teachers, or students in her district, while in others, every school, teacher or student (or groups of each) may be very different. In other words, the situations at various schools and for teachers or students in a district may be very similar or very different compared to the mean or "typical" situation[6].

We designed our questions to enable DTCs to estimate responses for the "typical," "modal," or "average" school, teacher, or student in their district. The DTCs are asked to provide an overview of their districts, and we are assuming that their jobs require them to know what is going on in their schools. If we had gathered information at the school level or below, we would have had to aggregate responses. We would have been dependent upon responses being "representative" at the school, teacher, and student level. By asking the DTCs to do the aggregating for us, we have collected data based upon substantial expertise and experience, and in a much more cost-effective manner than would have been the case in a more disaggregated set of surveys. Representative state-by-state data directly from principals, teachers, and students would have required the selection of separate stratified random samples of each group in each of the 50 states, and follow-ups to ensure that we obtained sufficient numbers of responses from members of each group from each stratification category. Our approach is to rely on state technology directors to get as high a response rate from districts as possible; and our experience is that it is indeed possible to achieve high enough district response rates to ensure representativeness.

The data presented describes responses of DTCs. We report the percentage of DTCs who say their districts, or the teachers, classrooms, students, or schools in them, had a certain characteristic. When we describe any of these groups as having a certain trait, in fact, we are actually reporting what the DTCs say about their district regarding that trait. Except for information on districts themselves, all other information has been obtained indirectly, through reports from DTCs.

In calculating overall values of variables (counts or means) for each state, in many cases we weighted district responses according to the number of students in each district. We gave districts with more students influence commensurate to their size when the variable being reported pertained to students or teachers. When we were simply counting the number of districts or schools in a district with or without a certain characteristic, we did not weight the responses. It is important to emphasize that when we weighted particular questions, the percentage given indicates the percent of students represented by the district technology coordinators. So, if the weighted percent provided in a chart is 55%, the interpretation of that number is "technology coordinators representing 55% of students in their district" reported the following. We will utilize this language throughout the paper; however, in many cases we will simply provide the percentage and the weighting scheme will be indicated in both the corresponding table and in Appendix B.

In addition, we computed (and where appropriate, weighted) the corresponding responses of all districts combined from the 21 states with response rates of 40% or more. The latter provides some basis for comparison for an individual state, but is *not necessarily*—indeed not likely—a representative national sample of the state of technology in our nation's schools. Some very large states did not

[6] Two districts may report the same student/computer ratio, say 12:1. In one of these districts, all ten schools might have ratios of 12:1. In the other, the ratios might range from 5:1 to 40:1, with the average ending up at 12:1. The meaning of a 12:1 student to computer ratio is very different in these two cases.

participate. Those states that did survey their districts probably had a greater interest in technology, and were further along in putting it in their schools, than were non-participating states.

Nevertheless, we do have responses from over 1,990 districts out of approximately 3,668 districts that were sent surveys in the 21 participating states. This report compares districts from individual states to an aggregation of all responding districts from 21 states that achieved at least a 40 percent response rate. The overall response rate in the 21 states was 54.3%. The cautions stated must be kept in mind, particularly that we are not talking about a representative national sample.

Many of the survey questions required that the DTC respond on a five point Likert scale where 1 represents the lowest value on a continuum (i.e., never, not important) and 5 represents the highest value (i.e., always, very important). In what follows, we report the percentage of DTCs responding 4 or 5 on each item unless otherwise indicated. In effect, we are identifying those who select at the top end of the scale, but we do not want to restrict ourselves to reporting on only the highest value as some respondents may be reluctant to use that ranking.

Uses of the Data

We present two different types of information in this report, both of which should be helpful for policy and planning in the states. First, there are many tables that simply describe the presence or absence of certain factors or conditions, or the magnitude, frequency, or intensity of various factors. Such measures establish baseline levels for each variable for each state in this, our first report. States need to know where they are now in order to get where they want to be in the future. In subsequent years, there should be substantial interest in changes (growth or decline) in these factors as states progress with their technology initiatives at different rates[7]. These baseline data can serve other more proximate purposes as well. The tables present data on each state separately as well as combined data for all districts that responded from all states. An individual state can compare its own data to the overall statistics and to data from any other states it considers relevant in order to see how it ranks. Although the overall figure is not necessarily the ideal, policymakers may be stimulated to act if they see their state lagging far behind others in regard to factors they see as important. And where a state is ahead of others, it may strive to keep its advantage.

The second type of information in this report is evidence on relationships among the variables that we measured. The ultimate goal of research on education technology is to identify the existence and magnitude of its impact on student learning, attitudes, and behaviors. Thus, using cross-sectional data by district we attempt to identify factors related to changes in students. Also, we believe that teacher attitudes could be significant in determining how technology impacts students, so we try to identify correlates with positive teacher attitudes about technology.

[7] Such year-to-year changes will have to be viewed with caution. Although our response rates are very good, it is possible that responding districts might be the most advanced in regard to technology (and so, most interested in the survey). If response rates are higher next year, that could mean that less advanced districts have started to participate, and the participation of less advanced districts could cause some of the progress indicators to decline. This would be due to the changing nature of the group of participating districts, and could occur even though every district has made progress since the earlier survey.

LEARNERS/LEARNING ENVIRONMENTS

In looking at the Learners/Learning Environments dimensions, we are asking...Are learners using the technology in ways that deepen their understanding of the content in the academics standards and, at the same time, advancing their knowledge of the world around them? Is the learning environment designed to achieve high academic performance by students through the alignment of standards, research-proven learning practices and contemporary technology?

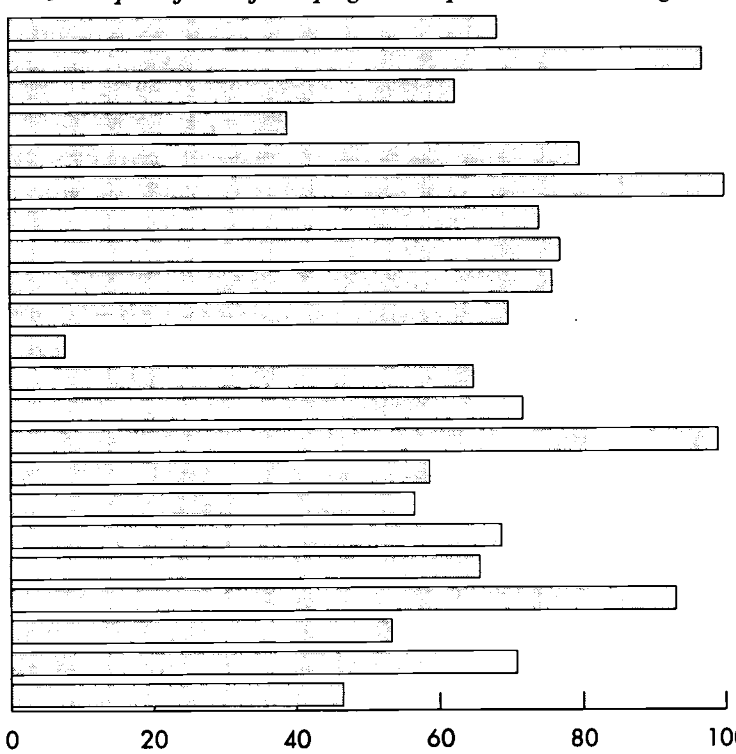
The ultimate goal of school technology efforts must be to get improvement in the academic performance of students. Presumably, students will learn while using technology, and thereby learn more and better about both the basic disciplines and technology itself. An intermediate step in this process is to make sure teachers understand and accept technology and use it optimally in the classroom. Thus, the first question we address is what are teacher attitudes towards technology.

To get a handle on teacher attitudes, we asked district technology coordinators (DTCs) to indicate where teachers in their district fell on a scale where 1= "They believe technology is just another fad being mandated by those above them," and 5= "Technology is a powerful tool for helping them improve student learning. On average across the 21 states, 68.3% of DTCs weighted by the number of students in their district rated teachers as 4 or 5, and the mean of all responses was 3.8. A majority of teachers (but not all by any means) were said to view technology as a powerful educational tool, but we are still quite far from unanimity (Table 2). According to DTCs, attitudes toward technology ran the gamut from Maryland, where DTCs representing only 7.8% of students were thought to have teachers who believe technology is a useful tool, to Alaska, where DTCs representing 97% of students had teachers who were thought to believe technology is a useful tool[8].

Table 2 - WEIGHTED ***Teacher Attitude Toward Technology.*** *Percent indicating 4 and 5.*

In general, where do teachers in your district fall on a scale in which 1 indicates that "they believe technology is just another fad being mandated by those above them" and 5 is "a powerful tool for helping them improve student learning?"

Overall	68.3
Alaska	97.0
Arkansas	62.4
Delaware	39.0
Florida	79.8
Hawaii	100.0
Indiana	74.1
Kansas	77.0
Kentucky	75.9
Louisiana	69.8
Maryland	7.8
Minnesota	64.8
Mississippi	71.7
Missouri	99.0
North Carolina	58.7
Oklahoma	56.6
Pennsylvania	68.7
South Carolina	65.6
Utah	93.1
Washington	53.3
West Virginia	70.8
Wyoming	46.5



[8] Because Maryland was such an outlier, we checked the responses from that state. In fact, we received responses from 14 of 21 districts. DTCs from 8 of these responded with a 3 and one other responded with a 2. Thus, 64% of *districts* responded at below the 4-5 range. However, these districts contained over 92% of the students from responding districts, and so, the weighting causes the extreme result.

We then asked about how teachers use technology, and we suggested six possible ways they might do so (Table 3). Overall, DTCs representing 63.6% of students indicated that teachers in their district frequently enhanced their curricula by integrating technology-based software into the teaching and learning process. This was the most frequent use in 15 of our 21 states; it ranked second in four others, and third in one[9]. Teachers frequently integrated technology-based software in districts representing 91.7% of students in Alaska as well as in districts representing only 42.5% of students in Wyoming.

Table 3 - Weighted

How Teachers Use Technology in the Classroom
Percent responding 4 and 5 on a scale in which 1 is "Never" and 5 is "Almost Always."

	Curricula are enhanced by integrating technology-based software into the teaching and learning process.	Teachers expect that students turn-in class assignments produced with technology (i.e., word processing, email, spreadsheets).	Teachers use technology to provide more inquiry-based learning projects.	Teachers adjust their teaching practices to meet individual student needs with the help of technology.	Teachers use cooperative group learning processes.	Project-based learning takes place.
Overall	63.6	35.8	32.7	27.2	46.5	43.7
Alaska	91.7	45.2	77.3	60.6	87.4	92.5
Arkansas	45.1	27.6	28.4	20.2	52.7	47.9
Delaware	58.5	24.9	25.7	26.4	31.7	10.8
Florida	68.3	24.9	28.2	18.2	82.6	48.4
Hawaii	0.0	100.0	0.0	0.0	100.0	100.0
Indiana	68.7	44.2	41.1	33.1	39.0	38.9
Kansas	64.3	65.1	37.2	31.1	35.1	46.2
Kentucky	67.5	47.4	43.2	39.1	49.0	43.0
Louisiana	88.0	4.3	22.1	39.4	59.0	50.0
Maryland	58.0	5.4	2.0	1.3	21.4	9.1
Minnesota	74.1	48.7	51.1	47.1	23.7	50.1
Mississippi	64.4	41.6	54.9	23.5	33.9	40.3
Missouri	81.8	68.0	79.4	52.5	92.9	76.7
North Carolina	62.3	19.9	21.2	17.0	20.7	25.2
Oklahoma	50.2	20.2	27.9	33.6	28.5	27.3
Pennsylvania	58.6	42.4	42.9	36.2	48.0	50.8
South Carolina	68.9	25.0	26.3	24.8	51.9	40.3
Utah	56.8	55.9	16.3	9.8	21.3	33.3
Washington	77.0	33.5	35.2	25.6	44.5	49.5
West Virginia	57.2	51.8	38.8	27.7	43.0	39.7
Wyoming	42.5	38.8	25.8	25.2	25.0	28.6

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[9] We do not include Hawaii in these counts because it has only one district. Thus, each item only can have a response of either 100% or 0%.

The second most frequent way teachers use technology in all districts combined is for cooperative group learning processes (46.5%). This use was ranked first in Montana (92.9%), Florida (82.6%), and Arkansas (52.7%). The range of frequent use for cooperative learning was from districts representing 92.9% of students in Montana and 82.6% in Florida to 20.7% of districts in North Carolina. DTCs representing 43.7% of students overall indicated that project-based learning frequently takes place in their districts' classrooms. This was the top use in Alaska (92.5%). Maryland (9.1%) and Delaware (10.8%) used this method frequently in fewest of their districts.

After that there was quite a fall off in the frequency of teacher use of suggested approaches, with districts representing 35.8% of students overall indicating that their teachers frequently expect students to turn in class assignments produced with technology (i.e., word processing, email, spreadsheets), and districts representing 32.7% of students overall indicating that their teachers frequently use technology to provide more inquiry-based learning projects. DTCs representing 27.2% of students overall reported that their teachers frequently adjust their teaching practices to meet individual student needs with the help of technology. This was the least frequent way technology was used overall. To summarize, the most frequent uses teachers make of technology are integrating software into their teaching, cooperative learning, and project-based learning. These are the types of uses of technology predicted and advocated by experts in teaching and learning.

The differences across states and districts in teachers' beliefs about the faddishness versus the power of classroom technology has led us to ask what factors are associated with these beliefs. One obvious hypothesis is that the more frequently teachers use technology in educationally sound ways, the more they will recognize it is a powerful tool for helping them improve student learning[10]. In fact, for each of our six suggested teacher uses of technology, when DTCs indicate more frequent teacher use, they also indicate greater propensity of teachers to view technology as a powerful learning tool. These correlations ranged from .346 for use of technology for inquiry-based learning to .273 for cooperative learning, and were all statistically significant at the .01 level (Table 4).

Table 4 ***Relationships Between Teacher Attitudes Towards Technology and How Teachers Use It***

Frequency of Teacher Use	Correlations with "Fad" variable		Regression coefficients dependent variable "Fad"			adj r square
	corr	sig	beta	sig.	t	
Curricula are enhanced by integrating technology-based software into the teaching and learning process.	0.337	0.01	0.153	6.151	.000	0.183
Teachers expect that students turn-in class assignments produced with technology (i.e., word processing, email, spreadsheets).	0.279	0.01	0.085	3.466	.001	
Teachers use technology to provide more inquiry-based learning projects.	0.346	0.01	0.105	3.614	.000	
Teachers adjust their teaching practices to meet individual student needs with the help of technology.	0.341	0.01	0.127	4.670	.000	
Teachers use cooperative group learning processes.	0.273	0.01	0.055	1.981	.048	
Project-based learning takes place.	0.285	0.01	0.051	1.795	.073	

[10] Of course we cannot determine the direction of the effect: does proper use enhance the belief or do those who believe strive to use it?

In Table 4 we also attempted to explain differences in the belief variable by differences in the frequency of use of all six methods in a multiple regression. All six uses were positively related to the belief variable; four were statistically significant at the .00 level (integrating technology-based software, producing assignments using technology, providing inquiry based learning projects, and adjusting for individualized instruction); one was significant at the .05 level (useing of cooperative group learning processes); and one at the .1 level (implementing project-based learning). Differences in the extent to which teachers in various districts use technology can explain 18.3% of the differences in teacher attitudes toward technology in different districts. Those who make better use of it recognize its power more.

We hypothesized that other factors in the professional competency, system capacity, and technology capacity dimensions might also be related to the value teachers place on technology. These include the total hours of technology training the typical teacher in a district receives, the extent to which teachers use technology in their own practice, whether or not teachers are given incentives for acquiring technology fluency and/or for changing their teaching methods to take advantage of technology, how much of their district's technology plan has been funded to date, and the annual cost per student of the plan. We would predict that where teachers get more training and use technology for their own benefit, they would be more likely to recognize technology's power. This should also be the case where a district spends more per student on technology and when a district's plan is closer to being fully funded. In fact, differences in all of these factors explain only 12.3% of the differences across districts in DTC reports of teacher views about the power of technology for schools. That they explain less than do measures of how teachers change classroom practices seems to imply that the best way to gain insight into the power of classroom technology is to use it properly in the classroom. We cannot depend on teachers getting training, being given incentives, using it in one's own work, or having a rich and well-funded plan to insure that they appreciate the value of learning technology. They must also use it in their classrooms.

PROFESSIONAL COMPETENCY

In looking at the Professional Competency dimension, we are asking...Is the educator fluent with technology and does he/she effectively use technology to the learning advantage of his/her students? In this section we inquired about the amount of training teachers received over the past twelve months and their skill levels in various uses of technology (Tables 5a and 5b). Overall, teachers received 12.8 hours of training. When we asked DTCs how much training teachers received in specific tasks (e.g. Internet use, software applications), and allowed training time to be credited to more than one task, it appears that on average, teachers were working on about 3 tasks at any one time[11]. They spent the most training time on software applications, followed by computer use, Internet use, and integrating technology into instruction. The average number of hours of total technology training received by teachers ranged from highs of 16 hours per year in North Carolina and 15.7 hours in Washington to lows of 5.8 hours per year in Maryland and 6.2 hours in Delaware.

However, DTC rankings of teacher skills were more variable. Depending on the particular skill, there was quite a range in the percent of students represented by DTCs whose teachers were ranked as

[11] When we summed hours of training received on all specific tasks, the total was 36.9 hours. Since actual hours spent was 12.8, on average each hour was spent on 3 tasks.

Table 5a - Weighted

Teacher Training
Typical hours of training over past 12 months

	Computer use	Software applications	Internet use	Multimedia peripherals	Online projects	Using distance learning equipment and infra-structure	Integrating technology into instruction	Using email	Other, please specify	Total hours of training over the past 12 months (not the sum of the above)
Overall	6.1	6.5	5.5	3.0	2.7	1.3	5.1	2.8	3.9	12.8
Alaska	10.8	9.5	9.6	4.3	5.4	3.0	8.7	2.8	2.5	11.3
Arkansas	6.0	5.0	4.5	1.5	2.0	0.4	3.8	3.3	1.2	10.2
Delaware	4.8	4.8	2.5	1.2	0.6	2.0	4.3	1.7	0.9	6.2
Florida	3.9	5.2	4.8	3.0	2.5	1.9	4.0	1.9	9.9	14.6
Hawaii	6.0	6.0	10.0	5.0	10.0	6.0	10.0	4.0	0.0	7.0
Indiana	4.7	6.9	3.5	1.7	1.7	0.9	3.7	1.7	0.9	11.9
Kansas	6.1	7.6	6.0	2.8	2.0	0.7	5.6	4.3	0.1	9.1
Kentucky	5.6	5.5	3.8	1.6	1.3	1.1	3.9	2.7	1.4	8.1
Louisiana	6.7	8.6	6.4	5.0	4.6	1.1	7.0	3.0	1.7	12.5
Maryland	2.0	2.0	1.4	0.5	0.3	0.0	1.2	0.4	0.0	5.8
Minnesota	4.8	5.3	4.2	1.7	2.1	0.5	3.6	2.0	0.9	11.5
Missouri	7.1	7.7	4.9	2.4	1.7	0.5	5.5	3.7	2.1	14.4
Mississippi	8.4	7.8	4.5	3.1	1.8	1.3	4.9	2.4	3.3	12.3
North Carolina	7.7	7.7	5.2	3.7	2.5	0.5	6.1	3.1	4.5	16.0
Oklahoma	5.8	5.3	4.3	2.3	1.4	0.5	3.3	2.2	8.8	11.2
Pennsylvania	7.0	6.3	5.8	2.3	2.0	0.9	5.5	3.4	1.7	15.0
South Carolina	7.5	9.2	8.4	8.3	4.1	1.6	8.1	4.0	6.0	14.4
Utah	6.3	6.7	7.2	2.2	3.0	1.3	5.3	4.7	8.1	8.8
Washington	6.5	7.1	5.7	2.6	4.5	2.0	4.8	1.7	2.2	15.7
West Virginia	8.9	8.3	6.5	4.1	2.2	0.2	5.3	3.4	2.8	12.2
Wyoming	5.9	5.2	3.5	1.5	2.8	0.9	2.7	1.9	7.8	10.2

Table 5b - Weighted

Skill Level of Typical Teacher
Percent responding 4 and 5 on a scale in which 1 is "Beginner" and 5 is "Advanced."

	Computer use	Software applications	Internet use	Multimedia peripherals	Online projects	Using distance learning equipment and infra-structure	Integrating technology into instruction	Using email	Other	Average percent competent
Overall	13.4	12.5	15.5	3.8	6.2	6.2	13.3	25.8	12.6	12.14
Alaska	3.3	16.4	16.5	0.0	2.5	3.3	1.8	6.2	0.0	5.56
Arkansas	5.2	5.2	13.2	3.8	1.9	5.6	7.1	26.6	19.6	9.80
Delaware	0.0	0.0	5.4	0.0	0.0	0.0	0.0	6.7	0.0	1.34
Florida	3.9	11.1	1.4	3.8	5.0	32.6	40.3	15.1	15.5	14.30
Hawaii	0.0	0.0	100.0	0.0	100.0	0.0	0.0	100.0	0.0	33.33
Indiana	15.1	15.1	9.3	6.7	3.7	0.6	6.8	28.4	13.8	11.06
Kansas	18.3	12.3	6.7	3.3	2.2	1.2	9.8	44.2	8.7	11.86
Kentucky	22.9	15.4	18.4	1.5	7.2	0.3	16.7	38.5	0.0	13.43
Louisiana	0.0	0.0	8.2	2.5	0.0	0.0	8.9	2.5	0.0	2.46
Maryland	1.3	1.3	1.4	0.0	0.0	0.0	0.0	3.4	0.0	0.82
Minnesota	32.5	21.7	20.7	1.2	2.1	0.8	10.4	49.8	15.4	17.18
Mississippi	18.3	6.8	8.0	10.6	2.5	2.7	7.8	13.4	8.7	8.76
Missouri	21.1	13.9	9.4	3.5	0.0	0.0	7.1	69.6	46.9	19.06
North Carolina	29.9	18.5	4.3	0.0	0.0	0.8	2.7	16.8	6.3	8.81
Oklahoma	2.0	9.4	6.2	0.4	0.1	1.2	3.2	4.8	8.7	4.00
Pennsylvania	18.0	18.9	23.1	2.5	2.2	2.4	9.7	22.5	12.7	12.44
South Carolina	11.5	12.2	13.3	8.4	3.0	0.1	20.5	19.8	33.0	13.53
Utah	12.8	11.8	54.2	19.0	24.4	0.7	24.7	46.3	0.0	21.54
Washington	17.8	14.3	10.6	1.7	4.8	3.0	5.6	45.8	0.0	11.51
West Virginia	9.3	7.4	8.2	0.0	0.0	0.0	3.4	17.9	25.1	7.92
Wyoming	14.1	18.0	19.5	1.4	6.8	5.0	3.9	11.2	50.3	14.47

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"advanced" (4 or 5 on a scale where 1= "beginner" and 5= "advanced"), with the highest share (25.8%) being advanced in using email and the lowest (3.8%) advanced in using multimedia peripherals. Although districts indicated that their teachers received a very small amount of training in using email (2.8 hours out of over 36 hours when considering training on multiple tasks during each hour), they also reported that more teachers were skilled in using email than in performing any other technology-related functions. One reason teachers might get relatively few hours of training in how to use email is that more of them already know how to use it—they might have been trained but prior to the 12 month period we ask about. Or email might not require much training. However, these findings still suggest that teachers are limited in their technological skills. Clearly, teachers have a long way to go before they are to be rated at having high levels of skills in all of the uses of modern technology deemed valuable in their classrooms.

As we look across the states at the DTCs who considered teachers "advanced" in particular skills, several interesting patterns emerge. There were nine different skills we suggested teachers might have (including an "other" category). We recognize that teachers in all states do not necessarily need to be advanced in every suggested skill; distance learning, for example, may not be relevant in some states. Nevertheless, for expository purposes only we averaged the "percent advanced" (4 or 5) over the nine skills for each state and used the average to rank the states on overall skill levels of teachers. For all 21 participating states together, the "average advanced skill score" was 12.14, which means that on average DTCs representing 12.14% of students rated teachers in their district as advanced in a particular technology skill. In other words, according to DTCs, less than 15% of teachers have advanced skills in technology.

For individual states, the range of scores was from 21.54 in Utah to .82 in Maryland. According to DTCs, Utah teachers' greatest strengths were in internet use (54.2% advanced), using email (46.3%), integrating technology into instruction (24.7%), and on-line projects (24.4%). Using email was the greatest strength of teachers in the next two most highly rated states, Missouri (overall score of 19.06) and Minnesota (overall score of 17.18). Wyoming had an overall score of 14.47, and the highest proportion of that state's teachers were advanced in Internet use (19.5%). Florida (14.3 overall) and South Carolina (13.53 overall) both had the highest share of their teachers advanced in integrating technology into instruction. Kentucky (13.43) and Pennsylvania (12.44) were the other two states with overall scores above the average score for all states. Following them were Kansas (11.86), Washington (11.51), Indiana (11.06), Arkansas (9.80), North Carolina (8.81), Mississippi (8.76), and West Virginia (7.92). Even DTCs in the states with the most skilled teachers do not indicate very high levels of teacher skills.

Although DTCs in most states give a generally negative view of their teachers' skills, those in the bottom states are saying that virtually all teachers have moderate technology skills at best. The bottom five states according to our crude measure of teacher technology skills were Alaska (5.56), Oklahoma (4.00), Louisiana (2.46), Delaware (1.34), and Maryland (.82). The Maryland score indicates that, on average, DTCs representing fewer than one percent of students in that state have judged that teachers in their districts have advanced skills in the skill areas listed.

The correlations between skill level of teachers in a district and the amount of training received by teachers in that district are consistently positive and significant (at least at the .05 level), but the correlations are usually small. The largest correlation was for using distance learning equipment and infrastructure (.451), followed by integrating technology into instruction (.287) and on-line projects (.274). For all skills, the more training teachers received the higher the share of DTCs who thought teachers were advanced in their level of skills (Table 6). As we well know, formal training in technology use is very important.

Table 6

Correlations Between Skill Levels and Hours of Training in Particular Uses of Technology

Skill Level	Average number of hours of training
Computer use	.068**
Software applications	.125**
Internet Use	.058*
Multimedia peripherals	.109**
Online projects	.274**
Distance learning	.451**
Integrating technology into curriculum	.287**
Email	.176**
Other	.388

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Another measure of teacher competency is the extent to which teachers actually use technology in their own work (Table 7). DTCs representing 37.8% of students in all districts said that their teachers use technology almost always to help with their administrative work and classroom management (for tasks like grade and attendance recording). Although this occurs most frequently in Utah (94.8%), Alaska (90.1%), Missouri (74.2%), Indiana (57.5%), Kentucky (53.3%), Washington (51.2%), and North Carolina (50.6%), there is still a long way to go to involve all or most teachers; even though use of technology for administrative tasks is often the first use teachers make of it.

Table 7 - Weighted

Extent to Which Teachers in District Use Technology in Their Own Practice
Percent responding 4 and 5 on a scale in which 1 is "Not at All" and 5 is "Very Much."

	Administrative work/classroom management (e.g. grade/attendance recording)	Communicating with colleagues	Accessing experts	Accessing training	Using simulations when teaching science	Using desktop publishing to teach writing
Overall	37.8	30.5	10.3	6.6	8.6	22.3
Alaska	90.1	74.1	18.9	16.0	5.6	40.0
Arkansas	24.5	30.2	4.5	3.7	5.6	13.9
Delaware	19.5	9.6	4.8	1.2	4.5	20.6
Florida	14.9	20.0	14.0	2.7	4.1	13.4
Hawaii	0.0	100.0	100.0	100.0	0.0	0.0
Indiana	57.5	33.6	7.7	1.0	10.7	28.3
Kansas	48.1	37.0	7.7	4.7	9.1	34.6
Kentucky	53.3	50.7	12.9	7.5	16.9	38.3
Louisiana	15.3	22.4	19.9	11.7	9.6	19.4
Maryland	3.5	2.0	0.0	0.0	5.8	0.0
Minnesota	41.2	36.4	4.3	18.2	25.0	43.8
Mississippi	23.7	20.7	2.6	11.2	7.6	22.3
Missouri	74.2	78.6	25.4	3.7	6.0	22.3
North Carolina	50.6	20.3	1.2	1.6	3.2	16.6
Oklahoma	30.9	7.3	2.7	2.4	5.8	14.0
Pennsylvania	36.2	23.4	5.6	3.9	15.4	29.4
South Carolina	38.8	26.0	8.1	11.5	2.6	29.9
Utah	94.8	55.8	11.8	1.0	1.8	26.1
Washington	51.2	53.0	11.9	0.4	10.0	15.5
West Virginia	36.0	21.0	6.9	4.6	1.3	12.2
Wyoming	47.1	39.5	10.1	1.3	8.4	32.0

The next two most frequent uses of technology were communicating with colleagues (DTCs representing 30.5% of students overall) and teaching writing using desktop publishing (22.3% overall). The other three suggested uses of technology received fewer "very much" ratings: accessing experts (10.3% overall), using simulations when teaching science (8.6% overall), and accessing training (6.6% overall). Teachers everywhere have a long way to go before they can be described as using technology in the most sophisticated ways.

System Capacity

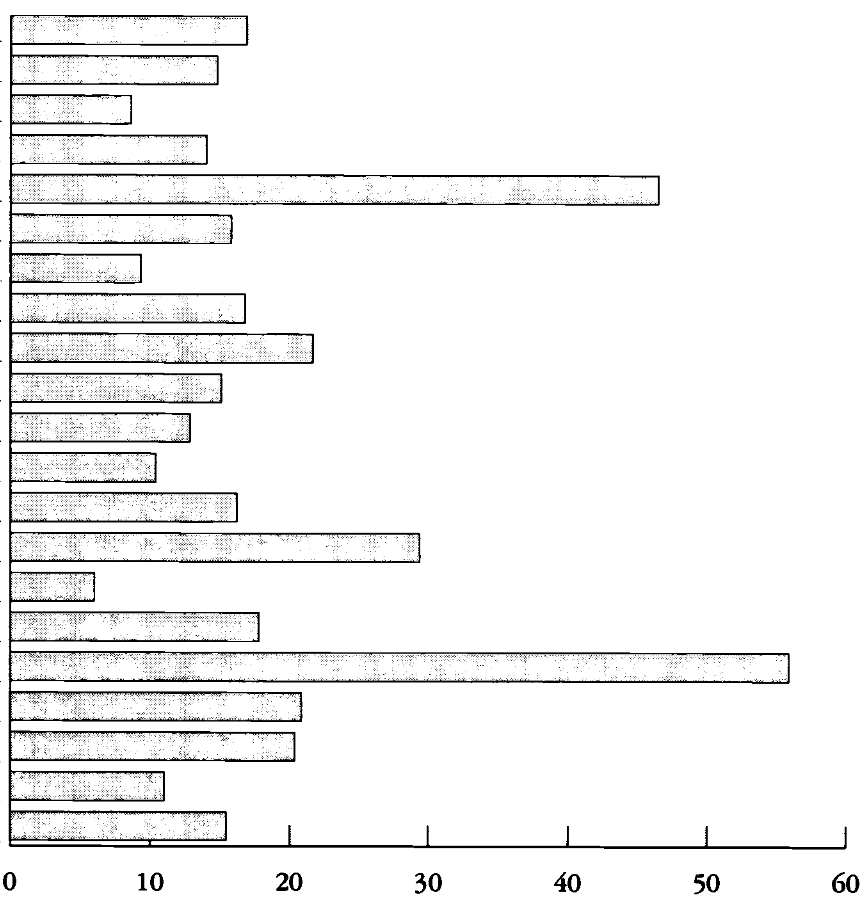
In looking at the System Capacity dimension, we are asking…Is the education system reengineering itself to systematically meet the needs of learners in this knowledge-based global society?

One measure of engagement of teachers with technology is their interaction with the district office regarding technology. Interaction with the district office could also be considered a measure of the capacity of a district to help teachers and schools. We asked about the average number of queries per week from teachers or schools that the district office receives regarding planning and implementation of technology. Overall, district offices averaged 17 queries per week in all 21 states. The range was from 56 queries per week in South Carolina and 46.5 in Florida, to 6 in Oklahoma, 8.6 in Arkansas, and 9.3 in Kansas (Table 8). These differences are even more striking when we realize that the average district size varied significantly across states. Either teachers in states like South Carolina and Florida are earlier on their learning curves than are teachers in states like Oklahoma, Arkansas, and Kansas (and so require more help), teachers in the former group are more involved in technology (and so come up with more questions), or states with more queries have a greater capacity to support their teachers' use of technology.

Table 8- Unweighted

Number of Queries per Week from Teachers or Schools that District Office Receives Regarding Planning and Implementation of Technology

Overall	16.9
Alaska	14.8
Arkansas	8.6
Delaware	14.0
Florida	46.5
Indiana	15.8
Kansas	9.3
Kentucky	16.8
Louisiana	21.7
Maryland	15.1
Minnesota	12.8
Mississippi	10.4
Missouri	16.2
North Carolina	29.4
Oklahoma	6.0
Pennsylvania	17.8
South Carolina	55.9
Utah	20.9
Washington	20.4
West Virginia	11.0
Wyoming	15.5



DTCs representing 53.2% of students overall said teachers in their districts received incentives for technological fluency and/or changing teaching methods to take advantage of available technology (Table 9). In nine of our 21 states, districts which enrolled over half of the students in their states provided such incentives: Alaska (87.65%), Utah, (73.8%), Washington (70.7%), Louisiana (66.9%), North Carolina (66.2%), West Virginia (66%), Pennsylvania (63.5%), Indiana (57.8%), and Mississippi (51.9%). Alaska seems to be a special case vis-à-vis incentives.

Table 9 - Weighted

Teacher Incentives for Technological Fluency or Using Technology

Percent responding yes.

	Frequency of Teachers Receiving Incentives for Technological Fluency and/or Changing Teaching Methods to Take Advantage of Available Technology	Incentives Districts Provide for Teachers Who Use Technology									
		Salary Supplement	Mentor teacher designation	Participation in special workshops	Release time	Additional resources for their classroom	Positive evaluations	School or district recognition program	Free or discounted computers for their own use	Free software	Other
Overall	53.2	19.2	25.6	52.3	38.0	45.0	29.6	15.7	15.3	18.9	6.3
Alaska	87.6	76.4	77.3	85.8	84.4	66.3	64.1	17.0	1.2	1.1	21.8
Arkansas	42.1	14.8	8.3	35.5	20.8	25.7	20.5	2.9	3.5	4.3	5.6
Delaware	48.2	11.3	11.0	28.7	24.0	29.3	19.0	24.3	4.8	19.2	3.2
Florida	32.9	13.5	22.6	31.8	26.7	31.9	30.5	22.3	14.6	19.4	0.0
Hawaii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indiana	57.8	30.9	26.5	66.2	49.3	54.1	39.5	16.7	17.9	26.4	1.7
Kansas	38.0	13.3	9.2	43.6	28.0	37.8	28.5	16.2	9.3	11.5	7.6
Kentucky	44.8	15.9	13.3	49.3	32.2	44.1	40.2	15.7	7.6	25.1	2.7
Louisiana	66.9	38.5	31.6	85.0	76.1	69.0	23.3	20.2	5.2	14.5	7.8
Maryland	39.1	2.2	1.6	39.1	2.9	36.9	7.1	3.8	0.0	1.6	0.0
Minnesota	43.4	20.3	15.3	39.1	33.0	24.6	25.7	6.1	7.1	7.8	12.9
Mississippi	51.9	2.3	4.9	49.7	22.3	46.7	33.5	21.5	10.4	12.3	2.9
Missouri	42.6	22.0	4.1	43.3	23.1	42.1	32.3	0.8	12.3	7.4	4.1
North Carolina	66.2	11.9	31.7	61.2	46.2	53.9	49.2	17.3	30.5	32.7	4.0
Oklahoma	36.3	7.0	16.7	35.8	29.2	33.5	10.8	8.4	8.9	15.6	0.2
Pennsylvania	63.5	11.1	40.0	65.4	54.6	49.7	21.5	9.9	27.0	27.4	7.1
South Carolina	55.4	19.5	22.2	43.2	30.1	42.6	30.7	10.4	19.5	12.0	10.5
Utah	73.8	35.4	27.5	71.2	23.6	69.6	44.3	9.8	17.0	0.4	0.0
Washington	70.7	52.5	48.1	63.7	44.1	58.9	36.1	45.6	15.5	40.3	21.1
West Virginia	66.0	8.3	11.6	53.4	54.3	41.7	27.8	10.6	13.7	20.0	25.3
Wyoming	44.5	20.9	24.1	50.6	41.3	25.7	26.3	19.1	5.2	1.2	4.6

The incentives provided most often were participation in special workshops (DTCs representing 52.3% of students overall) and additional resources for the classroom (45.0%). These were followed by: release time (38.0%), positive evaluations (29.6%), mentor teacher designation (25.6%), salary supplements (19.2%), free software (18.9%), school or district recognition programs (15.7%), and free or discounted computers for their own use was last (15.3%). Although many of these incentives are not used widely, our data suggest it may be possible to assess different impacts of various types of incentives. The results could indicate which incentive should be provided more broadly.

Virtually all districts (95.6% overall) have a formal technology plan and the remainder are in the process of developing one. On average, district plans covered 4.1 years (Table 10). The total cost of the typical district plan is meaningless without knowing the number of years covered and the number of students in the typical district (Table 11). Overall, districts averaged eight schools and enrolled 4,550 students. Adjusting for length of plan and number of students, we find that the average district technology plan costs $145 per student per year (Table 12). The range is from $227 in Delaware and $223 in Wyoming to $53 in Hawaii. Compared to total state education expenditures, these numbers generally are less than the 4% that the Milken Exchange has estimated will be required for full implementation and maintenance of school technology[12]. They exceed 4% only in Oklahoma. However, we expect that current district technology plan budgets are not the total amount that has been or will be spent on technology in the districts, and these expenditures do not include spending at the state level for things such as state networks, training and infrastructure.

Table 10 - UNWEIGHTED ***Districts that Have a Formal Technology Plan***

	Yes, we have a formal plan.	No, we are in the process of developing a plan.	No, we do not have a formal district technology plan.	Number of years covered in district technology plan
Overall	95.6	3.6	0.9	4.1
Alaska	97.0	3.0	0.0	3.7
Arkansas	91.6	6.5	1.9	4.0
Delaware	100.0	0.0	0.0	4.2
Florida	96.3	3.7	0.0	4.4
Indiana	98.1	1.9	0.0	5.0
Kansas	93.1	6.2	0.7	4.2
Kentucky	100.0	0.0	0.0	3.4
Louisiana	100.0	0.0	0.0	4.5
Maryland	92.9	0.0	7.1	4.5
Minnesota	94.2	4.7	1.2	3.8
Mississippi	100.0	0.0	0.0	3.7
Missouri	100.0	0.0	0.0	4.5
North Carolina	100.0	0.0	0.0	4.8
Oklahoma	95.4	2.3	2.3	3.9
Pennsylvania	95.5	4.2	0.3	4.1
South Carolina	90.8	6.6	2.6	4.7
Utah	100.0	0.0	0.0	4.9
Washington	96.0	3.3	0.7	4.0
West Virginia	89.5	7.9	2.6	4.2
Wyoming	91.7	8.3	0.0	4.0

[12] Solmon, L. C. and K. R. Chirra. *The Last Silver Bullet: Technology for America's Schools.* Santa Monica, CA: Milken Family Foundation, 1998.

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Table 11 - UNWEIGHTED

Size of Districts	Average number of schools in district	Average number of students in district
Overall	8.0	4,550
Alaska	9.2	3,126
Arkansas	3.9	1,662
Delaware	9.9	6,168
Florida	43.9	44,635
Indiana	6.2	3,291
Kansas	4.8	1,698
Kentucky	6.4	2,881
Louisiana	23.3	11,898
Maryland	41.5	23,864
Minnesota	4.6	2,334
Mississippi	6.4	3,521
Missouri	5.5	2,562
North Carolina	15.9	9,321
Oklahoma	3.8	1,486
Pennsylvania	7.4	4,278
South Carolina	12.8	7,684
Utah	19.3	13,131
Washington	6.4	4,328
West Virginia	15.3	5,708
Wyoming	7.5	2,055

Table 12 - WEIGHTED

Expenditure per Student per Year	Total 1995-96*	Weighted average plan cost**	Percent of expenditure to implement technology
Overall	6,146***	145.45	2.37%
Alaska	9,012	171.56	1.90%
Arkansas	4,710	104.39	2.22%
Delaware	7,267	226.84	3.12%
Florida	5,894	197.62	3.35%
Hawaii	6,051	52.63	0.87%
Indiana	6,040	154.92	2.56%
Kansas	5,971	189.12	3.17%
Kentucky	5,545	136.26	2.46%
Louisiana	4,988	138.73	2.78%
Maryland	7,382	187.23	2.54%
Minnesota	6,162	175.59	2.85%
Mississippi	4,250	89.47	2.11%
Missouri	5,626	110.87	1.97%
North Carolina	5,090	135.12	2.65%
Oklahoma	4,881	203.37	4.17%
Pennsylvania	7,492	127.35	1.70%
South Carolina	5,096	148.13	2.91%
Utah	3,867	69.10	1.79%
Washington	6,044	141.14	2.34%
West Virginia	6,325	127.08	2.01%
Wyoming	6,243	223.00	3.57%

* U.S. Department of Education, National Center for Education Statistics, Statistics of State School Systems; and Common Core of Data Surveys. (July 1998).
** Milken Exchange, Survey of Technology in the Schools.
***This total is for all states, not just the 21 that participated here.

For all 21 states combined, DTCs estimate that 44% of their districts' plan's cost has been funded (Table 13). This is a much larger percentage than we have estimated for the U.S. as a whole, which confirms our belief that states participating in this survey are further along than non-participants. Moreover, districts probably are further along with their plans than are the states with their statewide planning. The range of average percent of a district technology plan that has been fully funded across the states is surprisingly narrow, with the highest percentage fully funded in Minnesota (54.6%), Missouri (53.8%), and Mississippi (51.6%), and the lowest in Oklahoma (24.9%) and Arkansas (27.6%).

Table 13 - Unweighted

Cost and Funding of District Technology Plans

	Projected average cost per district of implementing technology properly and fully, based upon district technology plan amount	Expected to be reduced by E-Rate	Percent of district technology plan that has been fully funded to date (including the value of donated goods and services)	Percent of district capital budget currently going toward technology	Percent of district operating budget currently going toward technology
Overall	2,727,883	419,844	43.9	5.6	3.4
Alaska	1,908,690	227,855	46.3	4.1	3.4
Arkansas	685,557	86,229	27.6	4.6	3.7
Delaware	3,036,667	200,000	45.5	5.8	4.0
Florida	24,271,638	2,575,630	39.0	5.4	2.6
Indiana	3,071,161	284,641	50.0	15.2	3.2
Kansas	1,527,801	219,714	48.6	5.2	3.4
Kentucky	1,269,921	227,327	50.6	3.6	3.7
Louisiana	7,831,156	2,645,955	33.2	2.4	3.0
Maryland	21,130,145	3,721,003	34.8	1.9	2.8
Minnesota	1,756,661	159,090	54.6	11.2	3.4
Mississippi	1,113,507	226,181	51.6	4.7	4.2
Missouri	1,338,696	213,147	53.8	6.2	2.4
North Carolina	6,264,658	1,579,330	37.5	6.0	3.9
Oklahoma	1,091,008	208,931	24.9	3.7	4.2
Pennsylvania	2,352,009	364,710	49.3	4.4	2.9
South Carolina	4,704,731	568,307	42.1	4.2	2.9
Utah	4,408,310	225,967	51.7	5.4	2.0
Washington	2,726,957	344,331	43.7	5.7	3.7
West Virginia	3,094,028	508,390	37.7	3.2	3.3
Wyoming	1,730,851	23,447	51.3	2.2	2.6

In our 21 participating states, DTCs estimate that 5.6% of district capital budgets and 3.4% of district operating budgets are going toward technology (Table 13). These shares are consistent with the figures we calculated in Table 12. DTCs from Indiana and Minnesota indicate that their states fund technology through exceptionally high shares of their capital budgets (at 15.2% and 11.2 % of capital budgets respectively). The smallest shares of capital budgets were in Maryland (1.9%) and Wyoming (2.2%). Mississippi and Oklahoma each devoted 4.2% of their operating budgets to technology, while Missouri devoted only 2.4% and Utah 2%. Nonetheless these states represented ends of a very narrow range.

We asked the DTCs for the percentage of schools in each district that have benefited directly from various federal programs (Table 14). Although we intended to focus on the E-Rate and TLCF, the "other" category came out on top with DTCs from eleven states ranging from 96% of schools in Kentucky to 20.5 % in Florida indicating that they benefited from "other" federal programs, compared to 36.4% overall. This is likely because schools were using Title I and special education money for technology. The states with the largest share of schools benefiting from TLCF funds were Kentucky (85.8%) and Louisiana (78.2%). Florida (8%), Indiana (5.9%), and Minnesota (2.5%) had the smallest share of schools benefiting from TLCF. It is not surprising that Kentucky leads all participating states in getting districts involved with TLCF and in utilizing other Federal monies for technology. That state has been working on school technology for a relatively long time and has a sophisticated operation.

Table 14 - Unweighted

Percentage of Schools in District that Have Directly Benefited from Federal Funds or Discounts

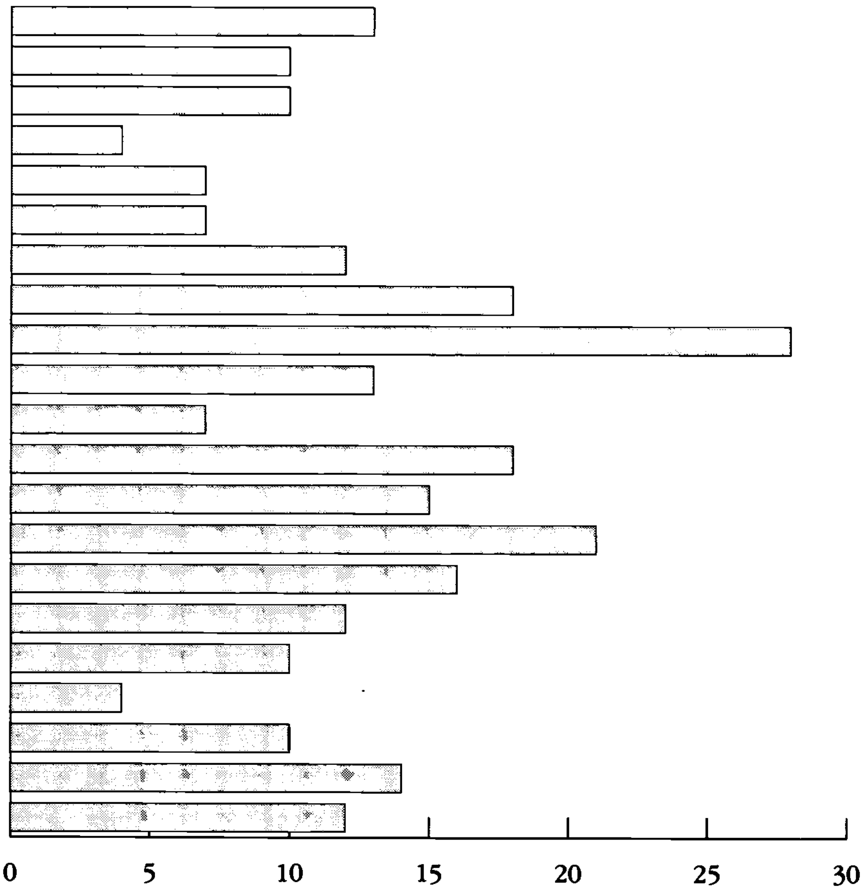
	TLCF	E-Rate	Other
Overall	23.3	31.8	36.4
Alaska	22.4	62.7	61.9
Arkansas	12.5	21.1	13.6
Delaware	24.7	11.1	48.5
Florida	8.0	17.4	20.5
Indiana	5.9	25.6	22.9
Kansas	20.6	27.6	17.5
Kentucky	85.8	49.7	95.6
Louisiana	78.2	72.6	90.8
Maryland	49.2	35.2	87.5
Minnesota	2.5	17.4	10.2
Mississippi	34.6	55.0	57.8
Missouri	22.5	25.9	76.4
North Carolina	25.5	30.3	37.1
Oklahoma	9.5	26.2	24.8
Pennsylvania	20.9	34.5	53.1
South Carolina	15.0	26.3	53.3
Utah	27.3	39.9	15.7
Washington	11.4	28.0	18.2
West Virginia	11.0	44.4	34.3
Wyoming	25.7	31.1	65.6

DTCs indicated that 31.8% of schools nationally had benefited from E-Rate discounts. This is surprising because no E-Rate discounts had been awarded by the time of this survey. Some DTCs may have been anticipating discounts in the future, but because others might have been considering only discounts to date (i.e., none), these numbers are meaningless. We had expected the E-Rate program to be further along by the time of this survey. In anticipating their E-Rate allocations, DTCs expected between 4% of their technology plan budgets in Delaware and Utah to 28% in Louisiana would be covered by these funds (Table 15).

Table 15

Percent of Budget Funded by E-Rate

Overall	13%
Alaska	10%
Arkansas	10%
Delaware	4%
Florida	7%
Indiana	7%
Kansas	12%
Kentucky	18%
Louisiana	28%
Maryland	13%
Minnesota	7%
Mississippi	18%
Missouri	15%
North Carolina	21%
Oklahoma	16%
Pennsylvania	12%
South Carolina	10%
Utah	4%
Washington	10%
West Virginia	14%
Wyoming	12%



FURTHER EXPLANATION OF TEACHER ATTITUDES

We now return to the question of what factors relate teacher attitudes regarding technology being another mandated fad or a powerful tool helping them improve student learning. To what extent are the total hours of technology training the typical teacher in a district receives, the extent to which teachers use technology in their own practice, whether or not teachers are given incentives for acquiring technology fluency and/or for changing their teaching methods to take advantage of technology, how much of their district's technology plan has been funded to date, and the annual cost per student of the plan related to teachers' views about the value of technology? Total hours of technology training is positively and significantly correlated with teachers' positive attitudes about technology, as was the availability of incentives to get training. The correlations between using technology in their own practice and their attitudes about its value for student learning are even larger. Cost per student per year of the district's technology plan was not related to teacher attitudes—we had surmised that richer plans would evoke more positive views. Similarly, the correlation between percent of the district plan that has been funded and teacher attitudes is not significant, seemingly saying that being closer to completion of a district plan, does not affect how teachers feel about technology!

When we tried to explain differences in attitudes by all of these factors together in a multiple regression, we found that very little of the attitudinal differences were explained—12.3% to be precise. This is less than what was explained by measures of the use of technology in the classroom that we discussed earlier. Hours of technology training, availability of incentives, cost per student, and percent of plan fully funded were not statistically significant. There were significant positive relationships between teacher attitudes towards technology and teachers using technology for administrative work/classroom management, for accessing experts, using simulations to teach science, and using desktop publishing to teach writing (Table 16).

Table 16

Explaining Teacher Attitudes Towards Technology
Teacher attitude toward technology: 1= "just another mandated fad," and 5 = "powerful tool."

Teacher use in own practice:	***correlation***	***sig stdzd beta***
Administrative work/classroom management	0.240**	0.113
Communicating with colleagues	0.236**	
Accessing experts	0.284**	0.141
Accessing training	0.233**	
Using simulations to teach science	0.202**	0.048
Using desktop publishing to teach writing	0.260**	0.131
Incentives for teacher training	0.116**	
Percent of plan fully-funded	0.084**	
Per student cost	-0.019	
Total hours of technology training for typical teacher	0.130**	
adj R sqd		0.123

**Correlation is significant at the 0.01 level (2-tailed).

When all the variables (the ones just discussed along with how teachers use technology in their classrooms) were combined in a single regression, seven use variables were significantly linked to teachers believing technology was a powerful learning tool rather than just another mandated fad. Four were classroom uses (integrating technology-based software, using technology for inquiry-based learning and for individualized instruction, and expecting students to turn in assignments using technology) and three were private uses (for administration, accessing experts, and desktop publishing). The largest significant standardized beta coefficients were for integrating technology-based software (.123), meeting students' individual needs (.119), and inquiry-based learning projects (.094). The next largest was use by teachers in their own practice: accessing experts and for administrative work (both at .091). Clearly, when teachers use technology they develop more positive attitudes about it. None of the suggested factors other than private and classroom uses were statistically significant when all of them were tested together. About 22% of the variance in the attitude variable is explained by these ways teachers use technology (Table 17).

Table 17

Explaining Teacher Attitudes Once Again

Teacher attitude toward technology: 1= "just another mandated fad," and 5= "powerful tool."

Teacher use in classroom:	correlation	sig stdzd beta
Integrating technology-based software into the teaching and learning process	0.337**	0.123
Expect students to turn in assignments produced with technology	0.279**	0.047
Provide inquiry-based learning projects	0.346**	0.094
Meet individual student needs with help of technology	0.341**	0.119
Co-operative group learning processes	0.273**	
Project-based learning	0.285**	
Teacher use in own practice:		
Administrative work/classroom management	0.240**	0.091
Communicating with colleagues	0.236**	
Accessing experts	0.284**	0.091
Accessing training	0.233**	
Using simulations to teach science	0.202**	
Using desktop publishing to teach writing	0.260**	0.049
Incentives for teacher training	0.116**	
Percent of plan fully-funded	0.084**	
Per student cost	-0.019	
Total hours of technology training for typical teacher	0.130**	
adj R sqd		0.224

**Correlation is significant at the 0.01 level (2-tailed).

WHAT IS THE EFFECT ON LEARNERS?

Our survey inquired about how students used technology and what the outcomes of such uses were. In order to analyze the relationship between how students use technology and its effects, we must consider intervening factors. These generally fall into the learning environment, technology capacity and system capacity dimensions for gauging progress of technology in the schools.

We asked about the percentage of student classroom time spent per week using computers or Internet technology (Table 18). Overall, DTCs reported that in elementary schools students spent 13.8%

of their time each week using technology, as compared to 14.7% of classroom time in middle schools and 17.1% of time in high schools. This 17.1% overall in 21 states, assuming a 6 hour school day, means students average one hour per day using technology. This is still a long way from full integration of technology into the curriculum. Hawaii is a clear outlier when we look at the percentage of time that students spend using technology across the state. Thirty to fifty percent of the classroom time of students at all school levels in Hawaii is spent using technology; this might make sense if we consider the isolation of many schools in that state. Otherwise, the range of time spent using technology is quite narrow. When we take the simple average of percent of time spent by students at the three levels of schooling, the range is from 17.8% in Alaska, 17.4% in Kentucky, 17.3% in Minnesota, and 17% in Indiana, to 12.7% in Delaware, 11.3% in Oklahoma, 10.8% in Florida, and 9.1% in Maryland.

Table 18 - Weighted

Percentage of Student Classroom Time Spent per Week Using Computers or Internet Technology

	Elementary schools	Middle schools	High schools	Average percent across grade levels
Overall	13.8	14.7	17.1	15.2
Hawaii	50.5	50.5	30.5	43.8
Alaska	16.8	19.5	17.2	17.8
Kentucky	15.2	16.1	20.9	17.4
Minnesota	14.0	17.2	20.6	17.3
Indiana	15.5	15.9	19.7	17.0
Missouri	12.0	15.4	23.4	16.9
Kansas	13.7	16.6	20.3	16.9
West Virginia	17.6	14.5	16.4	16.1
Louisiana	15.6	14.5	18.1	16.0
Mississippi	16.2	14.1	17.8	16.0
Pennsylvania	11.9	15.5	20.6	16.0
South Carolina	14.8	15.2	15.6	15.2
Washington	13.0	12.5	16.7	14.0
North Carolina	11.9	13.4	16.8	14.0
Arkansas	13.1	12.6	15.7	13.8
Wyoming	8.6	14.5	17.9	13.7
Utah	10.0	12.2	16.9	13.1
Delaware	12.5	9.5	16.2	12.7
Oklahoma	11.1	7.3	15.5	11.3
Florida	11.5	11.4	9.4	10.8
Maryland	9.3	9.1	8.8	9.1

TECHNOLOGY CAPACITY

In looking at the Technology Capacity dimension, we are asking...Are there adequate technology, networks, electronic resources and support to meet the education system's learning goals?

Earlier, we discussed the cost of district technology plans (Table 12). Now we ask what this money is buying? The student to computer ratio is probably the most frequently used indicator of progress schools are making regarding technology. It is also a measure whose meaning varies greatly depending upon what computers are included (i.e., the Apple IIes that are locked in the closet). The ratio is also a number that people have great difficulty reporting for some reason: reversing the numerator and denominator; giving the total number of computers rather than the number per student; and so on. Thus we must be careful to ask the question artfully and to include only valid responses.

Here we asked for the "number of students to each Internet capable computer available for student use" (Table 19)[13]. The weighted mean response was 36.3 students per Internet capable computer overall[14]. If correct, these ratios are far from the 4:1 or 5:1 we aim for—and presumably districts that responded to our survey are more advanced than others are. The high ratio for all states combined made us question its validity. A few districts indicated their ratio was almost 500:1. This may be unusual, but it could reflect schools of several thousand students with only a few Internet capable computers accessible to students. If there were 30 students per class, a 60:1 ratio tells us that schools have one Internet capable computer in half the classrooms. States with the lowest student to high-end computer ratio are Minnesota (10.1:1), Utah (11.4:1), Alaska (13.3:1), and West Virginia (13.5:1). At the high end were Louisiana (52.5:1), Mississippi (51.5:1), Pennsylvania (47.5:1), and Kansas (43.8:1). Oklahoma was a distinct outlier with a ratio of 131.7: 1. We looked specifically at the responses from Oklahoma to try to understand the reason for this exceedingly high number. In fact, two districts (out of 187 responding) which contained 43,256 students (or 13.2% of the total 298,370) said their ratios were 256:1. Also, one district with 3,614 students had a 400:1 ratio, and three districts with 37,000 students (11.3%) said their ratios were 500:1. If each of these last three districts had 12,333 students, at a student to computer ratio of 500:1, each would have 25 high-end computers available for student use. If the three districts had 10 schools in each, that would mean each school would have two to three high-end computers for students to use—perhaps in the library. Although these would not be well-equipped schools, the setup described is not beyond the range of possibilities[15].

[13] We did not define "Internet capable computer" because we thought that this would be clearly understood. Our intention was to find out how many computers could be hooked up to the Internet if there was a line available.

[14] We weighted the student to computer ratio by the number of students in each district. If a district with only 200 students had a 15:1 ratio, while a district with 20,000 students had a 5:1 ratio, the unweighted mean would be 10:1. That would not reflect the fact that the vast majority of students were in districts with a 5:1 ratio.

[15] We did decide to disregard responses of more than 500:1, which given the logic just provided, may be too conservative.

Table 19 - Weighted

Computers and Connections

	Ratio of Students to Computers Available for Student uUse that Are Capable of Accessing the Internet	Percentage of Schools in District that Have the Majority of its Classrooms:		
		Connected to a local area network (LAN)	Connected to the Internet via the LAN	Connected to the Internet via direct telephone line
Overall	36.3	56.4	48.5	21.5
Alaska	13.3	81.2	68.1	12.6
Arkansas	21.4	45.8	44.8	7.8
Delaware	17.7	65.2	70.7	18.8
Florida	41.8	50.1	46.6	37.2
Hawaii	0.0	87.5	87.5	0.0
Indiana	27.1	61.1	45.7	18.9
Kansas	43.8	61.7	47.7	18.0
Kentucky	16.0	75.2	66.7	19.0
Louisiana	52.5	40.0	31.9	12.6
Maryland	37.1	52.2	31.3	9.8
Minnesota	10.1	70.0	69.2	19.2
Mississippi	51.5	39.6	35.8	16.3
Missouri	18.7	48.7	54.4	11.6
North Carolina	41.1	51.0	32.7	41.3
Oklahoma	131.7	26.7	14.7	15.0
Pennsylvania	47.5	43.8	34.8	19.0
South Carolina	17.0	65.8	63.0	14.2
Utah	11.4	80.1	72.4	14.9
Washington	20.7	74.1	71.7	13.0
West Virginia	13.5	73.7	58.6	20.1
Wyoming	19.4	58.4	47.8	32.4

We must recognize that these ratios are very different than ratios that are normally presented—here we include only high-end computers, and only those available for student use. No wonder our ratios are higher. But it is the computers we include here that are most useful in enabling students to obtain the full benefits of modern learning technology. Table 20 compares the student/computer ratios weighted for each state from our survey (presented in Table 19) with data compiled by the private firm, Market Data Retrieval (MDR). MDR's student/computer ratio (collected at the school level) includes all instructional multimedia computers located anywhere in the school. But, these may or may not allow students to access the Internet. The MDR definition appears to include the computer on the teacher's desk and on those of administrators as well if it is used for instruction even if students are not allowed to touch it. In theory, the MDR ratio could be very low—and thereby make a state look good—even though no student had access to the Internet, or was even using a computer at all. Clearly, these ratios could be misleading.

Table 20

Student/Computer Ratios: A Comparison of Data Sources

	Milken Exchange: Students to computer ratio - for student use and Internet capable (weighted)	MDR: Students per instructional computer located anywhere in the school (not weighted)	Ratio: Milken/MDR
Utah	11.4	21.0	0.54
Minnesota	10.1	12.0	0.84
West Virginia	13.5	15.0	0.90
Kentucky	16.0	16.0	1.00
Alaska	13.3	10.0	1.33
Washington	20.7	15.0	1.38
South Carolina	17.0	12.0	1.42
Arkansas	21.4	14.0	1.53
Delaware	17.7	11.0	1.61
Missouri	18.7	11.0	1.70
Wyoming	19.4	10.0	1.94
Maryland	37.1	16.0	2.32
North Carolina	41.1	17.0	2.42
Indiana	27.1	11.0	2.46
Louisiana	52.5	18.0	2.92
Mississippi	51.5	16.0	3.22
Florida	41.8	12.0	3.48
Pennsylvania	47.5	13.0	3.65
Kansas	43.8	9.0	4.87
Oklahoma	131.7	13.0	10.13
Hawaii	Not Reported	15.0	

There is no systematic relationship between the Milken Exchange ratio and the one prepared by MDR. The rank order correlation among the states is only .04, which means that many states could be at the top of one ranking and at the bottom of the other. Only three states look better on our measure: Utah (11.4:1 versus 21:1), Minnesota (10.1:1 versus 12:1), and West Virginia (13.5:1 versus 15:1). Kentucky ends up the same on both measures and all the other participating states look worse when the Milken Exchange's ratio is used. This is not surprising when we consider that our criteria of Internet capable computers accessible to students is quite restrictive.

We began this section by asking what the money in district plans buys. However, there was a small and statistically insignificant (negative) correlation between expenditure per student per year implied by the cost of the current district plan and the student/computer ratio. We expected a strong negative correlation indicating where more money was to be spent, more top of the line computers would be available per student. In fact, the cost figure is for the plan now being implemented, and if

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districts had spent a great deal on computers in previous years under previous plans, they would have more computers available and might be spending less now and in the near future.

We also asked about how computers are linked to the Internet. On average, 56.4% percent of schools in a district have the majority of their classrooms connected to a local area network; the response was 87.5% in Hawaii, 81.2% in Alaska and 80.1% in Utah (Table 19). States with the fewest schools in districts having the majority of their classrooms connected to a local area network were Oklahoma (26.7%), Mississippi (39.6%), Louisiana (40%), and Pennsylvania (43.8%). (Note: if half the districts have half their classrooms connected, using only one computer in each classroom, that is consistent with the 36:1 ratio just discussed.) Thus, 48.5% of schools in all 21 states had the majority of their classrooms connected to the Internet via the LAN; and another 21.5% overall were connected to the Internet via a direct telephone line. Hawaii (87.5%), Utah (72.4%), and Washington (71.7%) had the largest share of their schools with at least half the classrooms connected to the Internet via their LAN. Greatest reliance on connections via direct telephone lines was in Florida (37.2%), Wyoming (32.4%), and West Virginia (20.1%).

Table 21 - Weighted

Technical Support and Maintenance for Technology

	When Technology at Schools Breaks Down, Time it Typically Takes to Fix the Problem		Frequency of Providing Technical Support or Maintenance for Technology *Percent indicating "Frequently."*								
	# of Hours	# of Days	Classroom teachers	Library media teacher	Other school staff hired specifically for those purposes (including computer lab teachers, computer aids)	Other school staff with additional responsibilities	District provides on contract or as needed	Commercial providers on contract or as needed	Students	Regional educational service agencies	Other
Overall	5.6	3.6	18.5	39.6	72.4	33.3	53.8	24.0	7.7	11.5	53.4
Alaska	3.9	14.6	71.5	49.4	91.5	43.9	86.5	13.9	8.8	0.0	4.5
Arkansas	6.0	2.0	10.5	30.6	68.0	19.3	17.8	12.9	2.9	11.9	49.3
Delaware	2.4	6.2	10.1	13.6	87.4	49.6	46.9	50.7	15.3	21.7	0.0
Florida	13.3	3.0	14.6	56.0	88.1	44.9	62.8	30.3	1.3	0.6	0.0
Hawaii	3.0	2.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0	0.0
Indiana	11.1	2.6	11.6	30.9	80.1	25.2	36.4	30.1	2.4	3.8	72.1
Kansas	4.9	4.0	9.8	45.4	77.9	47.6	54.6	15.1	2.5	1.5	12.9
Kentucky	10.8	2.7	11.5	48.0	63.9	46.8	53.6	25.4	26.7	2.7	75.6
Louisiana	7.4	2.9	48.3	36.8	54.2	41.0	36.6	46.3	7.8	0.0	51.0
Maryland	2.5	10.2	0.0	26.3	42.1	0.0	56.4	5.1	0.0	0.0	0.0
Minnesota	3.6	3.4	4.7	66.9	89.4	27.5	52.0	11.7	6.3	8.1	48.6
Mississippi	4.5	3.3	13.7	24.5	69.3	34.3	36.6	23.7	5.6	0.0	28.8
Missouri	3.9	3.4	18.2	41.4	79.5	14.3	12.2	14.3	18.1	0.0	76.4
North Carolina	7.3	4.5	13.8	66.5	62.8	28.7	67.8	20.5	1.5	0.4	60.4
Oklahoma	8.0	3.2	16.1	27.4	69.2	17.6	51.9	22.9	2.8	0.0	15.0
Pennsylvania	3.1	2.9	12.7	15.0	72.0	25.9	38.6	17.0	3.7	41.1	26.3
South Carolina	5.6	3.6	3.1	48.5	50.9	22.9	62.6	29.3	0.0	0.0	61.6
Utah	7.7	5.0	43.0	26.3	63.1	21.2	93.3	12.0	11.9	8.0	80.0
Washington	4.0	2.2	17.6	42.3	87.9	42.7	56.6	13.9	10.2	1.7	65.8
West Virginia	14.0	6.5	37.6	34.3	55.8	42.3	65.7	31.9	18.7	92.9	0.0
Wyoming	3.2	4.9	27.2	35.0	54.9	36.4	32.5	12.3	12.0	12.1	4.5

We identified a number of other interesting proxies for technology capacity. We asked, "when technology at your school breaks down what is the range of time it typically takes to fix the problem" (Table 21). We gave DTCs the option of providing the time in hours or days. For all 21 states taken together, the mean number of hours was 5.6 and the mean number of days was 3.6. The hour and day figures might be suggesting a range of the time it takes to get technology repaired.

We tried to understand who provides technical support or maintenance for technology in the districts by asking about the frequency with which various sources would provide such help (Table 21). In all responding districts in our 21 states, the source cited most often as frequently (DTCs representing 72.4% of students) providing the service was "other school staff hired specifically for those purposes (including computer lab teachers, computer aides)." This was followed by "district provides on contract or as needed" (53.8%), "library media teacher" (39.6%), "other school staff with additional responsibilities" (33.3%), "commercial providers on contract or as needed" (24.0%) and "classroom teachers" (18.5%). Students and regional educational service agencies were reported to be used frequently by DTCs representing 7.7% and 11.5% of students respectively.

Districts in Alaska, Florida and Delaware were most likely to hire staff to provide support. Utah, Alaska and North Carolina were most likely to have their districts provide support to the schools on contract or as needed; and the library media teacher was relied on most in Minnesota and North Carolina. In Alaska, DTCs representing 71.5% of students said that classroom teachers frequently provided technical support or maintenance; in Delaware, 49.6% of DTCs indicated that other school staff with additional responsibilities did so. Students were the source of such help most frequently in Kentucky; and regional educational service agencies were used most frequently in West Virginia.

Finally we inquired about the percent of computers at district schools that are not used (Table 22). The responses were in a remarkably small range. Across the 21 participating states, DTCs indicated that on average, 5.9% of computers in their districts were not used. The range was from 13.2% in Delaware and 9.2% in Utah on the high end, to 1.6% in Alaska and 2.1% in Minnesota on the low end. Then we asked about factors explaining why these computers are not used (Table 22). The most important factor was that the computers were outdated. Overall DTCs representing 67.9% of students said this factor was very important (by giving it a 4 or 5 on a 5 point scale where 1=not important and 5= very important). This was the most important according to DTCs in all states except Maryland and Missouri where the most important reason for lack of use was computers needed repair, which probably means they are old if not outdated. In both of these states outdated computers came in second. The next reason why computers were not used was that "teachers are not trained to use them" (DTCs representing 50% of students indicating this was very important overall, with a range between one half of one percent in Alaska to 94.8% in Maryland). This was followed by a need to revise the curriculum (34.9%), classrooms do not have the appropriate wiring (30.4%), no interest (29.9%), computers require repair (29.8%), no appropriate software (21.9%), and too many other computers (4.5%). Clearly, it is the rare district that has idle computers because it has too many of them.

Table 22 - Weighted

Important Factors in Explaining Why These Computers Are Not Used

Percent 4 and 5 on a scale in which 1 is "Not Important" and 5 is "Very Important."

	Percent of computers at schools in districtthat are not used	Teachers are not trained to use them	Classrooms do not have the appropri-ate wiring	No interest	Too many other computers	Outdated computers	Computers require repair	No appropriate software	Need to revise curriculum
Overall	5.9	50.0	30.4	29.9	4.5	67.9	29.8	21.9	34.9
Alaska	1.6	0.5	5.5	2.7	8.6	92.1	91.5	61.6	0.0
Arkansas	4.4	30.5	23.4	11.7	0.0	71.2	22.7	25.0	15.7
Delaware	13.2	58.0	0.0	14.4	0.0	36.7	36.4	15.3	36.1
Florida	7.9	73.3	29.3	33.6	0.3	55.7	27.3	17.0	40.2
Hawaii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indiana	5.5	47.6	25.5	25.3	0.4	69.5	19.3	25.0	39.7
Kansas	2.4	50.6	25.7	40.9	2.0	62.2	26.1	29.8	41.8
Kentucky	4.8	52.8	36.7	44.8	4.3	50.2	33.2	15.1	41.0
Louisiana	5.7	36.4	29.2	15.6	8.6	89.8	30.1	29.1	37.3
Maryland	8.5	94.8	0.0	39.5	7.6	54.0	82.8	46.6	14.6
Minnesota	2.1	20.5	0.7	26.2	1.9	83.9	23.6	13.6	10.9
Mississippi	4.7	46.3	40.0	31.2	8.6	69.3	33.5	37.7	32.3
Missouri	3.1	20.3	33.0	0.0	9.0	59.2	60.5	25.0	22.5
North Carolina	3.2	31.4	27.4	60.9	18.0	72.3	32.4	20.6	36.9
Oklahoma	5.0	32.5	20.7	16.3	0.5	51.9	28.2	22.8	11.4
Pennsylvania	5.0	59.6	65.3	23.6	2.7	68.8	10.0	11.1	52.5
South Carolina	5.6	32.9	32.9	17.9	15.0	70.2	22.4	26.4	27.0
Utah	9.2	55.8	40.0	63.9	0.5	79.8	68.8	33.0	9.8
Washington	7.8	18.7	11.3	12.3	1.2	83.3	16.6	8.8	51.9
West Virginia	4.5	42.6	9.3	61.9	0.0	68.3	40.8	56.3	27.8
Wyoming	6.9	54.1	31.1	8.5	5.8	72.0	7.0	20.3	14.2

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EVALUATION

On average, districts appear to evaluate technology use in schools on an annual basis. Yearly evaluation occurs in 53% of all responding districts (Table 23). 53.3% of districts in Delaware evaluate technology use more than once a year, while only 14.8% of districts in Kentucky and none in Maryland do so. Technology use is never evaluated in 7.8% of South Carolina districts and in 7.4% of Florida districts. In Table 24, we see that DTCs representing only 20.9% of students said their districts used technology in student assessment efforts frequently (4 or 5 on a scale where 1 = never and 5 = frequently). The range is from 42.5% in North Carolina and 35.1% in Florida to 6.3% in Washington, 1.3% in Maryland and 1.2% in Delaware. Clearly evaluation of and with technology still has a long way to go. Since policymakers demand evidence on the use and effectiveness of school technology in order to provide new funding, evaluation of technology use and use of technology for student assessment must become a primary concern of those advocating continuation and expansion of technology in the schools. Thus, we now turn to the impacts of technology on students.

Table 23 - Unweighted

How Often Districts Evaluate Technology Use in Schools

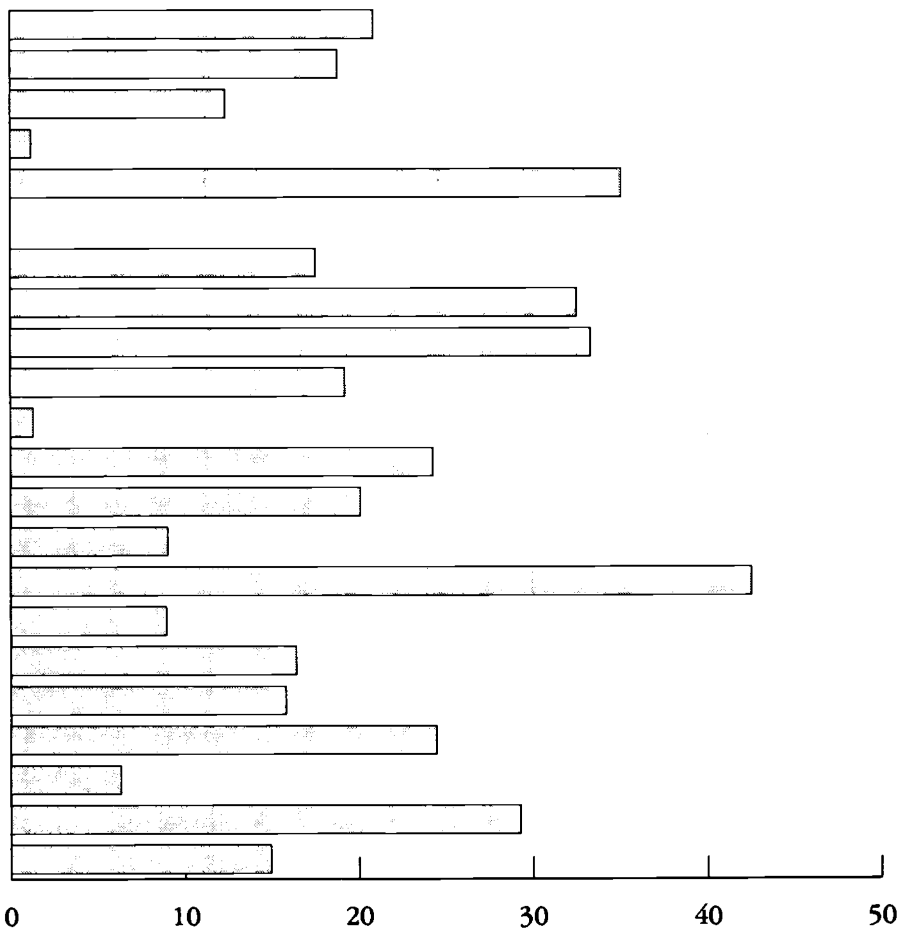
	More than once a year	Yearly	Less frequently than yearly	Never
Overall	27.0	53.0	17.1	2.9
Alaska	30.3	48.5	18.2	3.0
Arkansas	24.7	49.4	23.4	2.6
Delaware	53.3	33.3	6.7	6.7
Florida	25.9	63.0	3.7	7.4
Indiana	29.0	48.4	20.6	1.9
Kansas	33.1	49.0	15.2	2.8
Kentucky	14.8	59.0	21.3	4.9
Louisiana	25.0	63.0	5.6	5.6
Maryland	0.0	42.9	57.1	0.0
Minnesota	32.9	47.6	16.5	2.9
Mississippi	21.3	66.0	11.7	1.1
Missouri	22.7	59.1	13.6	4.5
North Carolina	21.9	64.1	12.5	1.6
Oklahoma	25.7	57.7	13.5	3.2
Pennsylvania	32.1	50.7	14.9	2.3
South Carolina	28.6	46.8	16.9	7.8
Utah	22.2	58.3	16.7	2.8
Washington	21.2	53.0	24.5	1.3
West Virginia	26.3	57.9	15.8	0.0
Wyoming	21.6	54.1	18.9	5.4

Table 24 - Weighted

Extent District Uses Technology in Student Assessment Efforts

Percent responding 4 and 5 on scale in which 1 is "Never" and 5 is "Frequently."

Overall	20.9
Alaska	18.8
Arkansas	12.3
Delaware	1.2
Florida	35.1
Hawaii	0.0
Indiana	17.5
Kansas	32.5
Kentucky	33.3
Louisiana	19.2
Maryland	1.3
Minnesota	24.3
Mississippi	20.1
Missouri	9.0
North Carolina	42.5
Oklahoma	8.9
Pennsylvania	16.4
South Carolina	15.8
Utah	24.5
Washington	6.3
West Virginia	29.3
Wyoming	14.9



STUDENT OUTCOMES

Given the extent of teacher use of and time spent with technology, we asked how students use technology (Table 25). DTCs representing 56% of students from around the country indicated that "students use technology in at least some of their regular classrooms." The next most frequent change in behavior due to use of technology was "students become more independent learners as a result of technology" (DTCs representing 54% of students in the 21 states). The next most frequently cited uses students make of technology were "students are developing on-line research expertise" (48% overall) and "students are interacting/communicating differently and more widely with the help of technology in the classroom," (rated 4 or 5 by DTCs representing 44.4% of students overall). These were the top four uses of technology made by students. Moving down the list, DTCs representing roughly 34.0% of students overall ranked 4 or 5 that "students use technology to improve their basic skills with drill and practice programs"—a big gap from the frequencies of the top four noted above. DTCs representing 31.3% of students overall said "students use computers only in a lab." Neither of these two uses of technology is thought to be very helpful in taking students to the cuttting edge of technology's potential. The next and least frequent three uses were: "to teach students how to use the technology itself" (13.9%), "students do more school work when not in school" (13.1%), and "students actively participate in distance learning with other schools" (7.5%). As seen in Table 25, there are significant differences among states in the ways students use technology.

Table 25 - Weighted

Frequency of Each of the Following Student Uses of Technology in Schools Within District
Percent responding 4 and 5 on a scale in which 1 is "Never" and 5 is "Almost Always."

	Students use computers only in a lab.	Students use technology in at least some of their regular classrooms.	Students actively participate in distance learning with other schools.	The primary student-related use of technology is to teach students how to use the technology itself.	Students use technology to improve their basic skills with drill and practice programs.	Students are developing online research expertise.	Students are interacting communicating differently and more widely with the help of technology in the classroom.	Students become more independent learners as a result of technology.	Students do more school work when not in school.
Overall	31.3	56.0	7.5	13.9	34.0	48.0	44.4	53.9	13.1
Alaska	19.0	97.9	18.9	1.0	4.0	86.2	86.9	86.9	32.4
Arkansas	48.9	41.5	2.5	33.0	39.4	46.8	42.0	42.2	6.7
Delaware	28.2	51.3	0.7	40.7	34.2	43.6	22.4	36.1	62.0
Florida	10.9	42.0	0.0	2.2	3.1	32.3	24.5	49.8	8.2
Hawaii	0.0	100.0	100.0	0.0	100.0	100.0	100.0	100.0	100.0
Indiana	31.2	62.0	14.2	12.2	27.8	57.6	46.4	54.7	16.9
Kansas	29.0	75.0	4.1	11.3	27.5	50.6	67.5	62.6	14.1
Kentucky	23.6	84.2	6.1	13.3	35.1	62.2	58.4	71.3	12.7
Louisiana	41.0	38.0	1.9	8.1	49.7	13.7	19.4	67.8	31.4
Maryland	24.0	52.0	0.0	3.3	36.4	32.0	1.3	3.3	0.0
Minnesota	43.0	57.8	4.2	7.6	16.4	71.1	70.1	70.3	5.3
Mississippi	34.5	56.0	13.0	15.8	41.2	47.4	47.8	51.3	13.2
Missouri	50.5	56.2	7.1	1.3	16.5	77.6	45.7	85.8	27.3
North Carolina	51.7	42.9	5.9	7.0	27.1	49.9	42.3	54.7	40.0
Oklahoma	36.9	49.6	4.3	28.7	65.8	29.2	33.4	41.5	2.5
Pennsylvania	36.7	52.4	8.6	35.0	53.3	51.8	49.1	29.6	17.6
South Carolina	23.7	58.3	9.8	10.2	30.4	56.5	42.1	66.5	14.4
Utah	57.8	41.7	2.7	7.0	35.8	52.0	38.8	12.2	5.2
Washington	16.0	81.8	1.9	6.0	17.8	42.2	45.1	70.1	15.1
West Virginia	33.2	69.2	3.8	11.2	63.8	62.3	41.3	51.5	46.1
Wyoming	55.8	48.6	2.5	10.6	22.1	36.8	41.2	63.7	16.2

To review, the top four changes in students' behavior due to technology are precisely the types of changes in student learning expected and desired from technology, namely use in classrooms rather than labs, becoming independent learners, developing on-line research skills, and interacting differently. Most of the activities getting frequency scores of 4 or 5 from DTCs representing 35% or less of the students are actually less progressive or more traditional uses of technology (drill and practice, lab only, to learn technology as an end in itself, etc.).

Educators who believe in the power of technology in the classroom cite a number of potential benefits from putting it in and using it properly. These range from outcomes most proximate to the use of technology, such as becoming more engaged in learning to learning more, with this being reflected in better grades and test scores. Some also believe that in the long run, attendance will improve and dropouts will decline as technology becomes more pervasive. We tested these views by asking DTCs how frequently such changes occurred in their districts. The most frequently cited student outcome (Table 26) due to the use of technology, (ranked at 4 or 5 by DTCs representing 60.6% of students) is "students are more engaged in learning." Next came "deepened student understanding of academic subjects," which was ranked 4 or 5 by DTCs representing 45.6% of students. There was then a sharp drop in the percent of DTCs indicating frequent occurrence of outcomes. Ranked third with DTCs representing only 27.8% of students indicating 4 or 5 was "schools report that students have better grades and/or test scores since they began using technology." Although many people predict that attendance will improve as technology use grows, DTCs (representing only 21.6% of students) said on a scale of 4 or 5 that "schools report an increase in attendance on days that students are scheduled to use technology." The lowest frequency score of 4 or 5 was for "student dropout rate has decreased due to the use of technology" (7.3% overall). It is difficult to isolate the effect of technology on most of the low frequency student outcomes. Also, many of these would require years of technology use before the impact would be measurable.

Table 26 - Weighted

Student Outcomes

Percent responding 4 and 5 on a scale in which 1 is "Never" and 5 is "Almost Always."

	Students are more engaged in learning due to technology.	Student understanding of academic subjects has deepened due to technology in the classroom.	Schools report an increase in attendance on says that students are scheduled to use technology.	Schools have reported decreases in the student dropout rate attributed to the use of technology.	Schools report that students have better grades and/or test scores since they began using technology.
Overall	60.6	45.6	21.6	7.3	27.8
Alaska	89.6	87.1	16.5	1.0	20.1
Arkansas	47.3	24.8	9.7	0.4	12.5
Delaware	78.3	36.1	46.7	16.0	28.2
Florida	39.5	33.2	42.6	11.1	27.1
Hawaii	100.0	100.0	0.0	0.0	100.0
Indiana	70.0	44.9	24.4	6.6	31.2
Kansas	69.6	40.6	11.9	7.7	25.2
Kentucky	68.9	55.9	25.4	5.7	42.5
Louisiana	58.9	51.0	35.2	14.0	39.5
Maryland	36.3	33.4	0.0	0.0	0.0
Minnesota	68.8	47.1	5.7	5.7	11.8
Mississippi	61.1	48.3	22.1	7.4	37.4
Missouri	94.7	69.6	27.9	15.2	54.5
North Carolina	68.6	37.9	76.5	15.3	39.4
Oklahoma	20.2	31.0	15.0	2.3	29.1
Pennsylvania	57.8	46.4	19.8	5.7	22.4
South Carolina	66.1	47.7	20.0	14.1	26.2
Utah	51.6	54.0	26.4	1.0	33.1
Washington	79.3	53.0	17.9	6.7	16.3
West Virginia	68.9	56.5	6.5	0.8	30.6
Wyoming	55.9	41.5	6.7	0.2	5.1

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We expected that students becoming more engaged learners would be the most frequently observed outcome because it is a precursor to learning more and behaving better. This was the outcome cited to occur frequently most often by DTCs in 15 of our 20 states (omitting the one district state of Hawaii which indicated that three outcomes occurred frequently, that is, in 100% of its one district). DTCs in Utah (54%) and Oklahoma (31%) said that deepening student understanding of academic subjects was the most frequently occurring outcome in districts in their states. DTCs in North Carolina (76.5%) and Florida (42.6%) cited attendance increases most frequently, while a decrease in the dropout rate was the outcome mentioned as occurring frequently by DTCs representing the most students in Louisiana (73.4%).

One of the most valuable results of our survey would be the identification of correlates of desired student outcomes. That is, it is important to know what factors are associated with these benefits of learning technology. We ran both simple correlations as well as multiple regressions to see whether various survey responses are associated with the five outcome measures just discussed. First we asked about the relationships between the nine ways we suggest students might use technology and student outcomes. In addition we hypothesized that an outcome will be observed more frequently when students spend more of their classroom time using computers or Internet technology, when their teachers have better technology skills, when there are incentives for teachers to get training in using technology, when technology is used in student assessment, when districts plan to spend more on technology and when more of what they plan is already funded, when the student to computer ratio is lower, and when fewer computers are unused. This set of variables is able to explain between 10% and 31% of the district-by-district variance in the frequency of occurrence of the outcomes, depending upon which outcome we look at (Table 27).

Table 27

Explanations of Student Outcomes

	Students are more engaged in learning due to technology.		Student understanding of academic subjects has deepened due to technology in the classroom.		Schools report an increase in attendance on days that students are scheduled to use technology.		Schools have reported decreases in the student dropout rate attributed to the use of technology.		Schools report that students have better grades and/or test scores since they began using technology.	
	correlation	**sig stdzd beta**	**correlation**	**sig stdzd beta**	**correlation**	**sig stdzd beta**	**correlation**	**sig stdzd beta**	**correlation**	**sig stdzd beta**
Students use computers only in a lab.	(0.019)		(0.036)		0.049*	0.081	0.040		0.016	
Students use technology in at least some of their regular classrooms.	0.277**	0.087	0.255**	0.061	0.020		0.003		0.136**	
Students actively participate in distance learning with other schools.	0.125**		0.161**		0.060**		0.117**		0.136**	
The primary student-related use of technology is to teach students how to use the technology itself.	(0.034)		0.003		0.067**		0.072**	0.058	0.033	
Students use technology to improve their basic skills with drill and practice programs.	0.076**		0.120**		0.055*		0.057*		0.132**	
Students are developing online research expertise.	0.308**		0.265**		0.040		0.037		0.138**	
Students are interacting/ communicating differently and more widely with the help of technology in the classroom.	0.455**	0.140	0.365**		0.083**		0.061**		0.216**	0.109
Students become more independent learners as a result of technology.	0.524**	0.354	0.451**	0.296	0.146**	0.103	0.107**		0.246**	0.085
Students do more schoolwork when not in school.	0.182**		0.283**	0.131	0.275**	0.210	0.259**	0.218	0.209**	0.143
Percent of classroom time spent using computers or Internet technology in elementary school.	0.195**	0.066	0.212**	0.132	0.125**		0.127**	0.130	0.182**	0.135
Percent of classroom time spent using computers or Internet technology in middle school.	0.233**		0.225**		0.148**	0.134	0.114**		0.150**	
Percent of classroom time spent using computers or Internet technology in high school.	0.231**		0.190**		0.107**		0.104**		0.149**	
Total tech skills of teachers	0.212**		0.208**	0.056	0.053*		0.057*		0.129**	
Extent technology is used in student assessment efforts.	0.193**		0.196**	0.056	0.091**		0.094**	0.065	0.177**	0.074
Incentives for teacher training	0.115**		0.102**		(0.012)		(0.018)		0.031	
Percent of plan fully-funded	0.108**		0.093**		(0.056)*		(0.040)	(0.060)	0.002	
Per student cost	0.024		0.010		0.014		(0.017)		(0.027)	
Student/computer ratio	(0.057)*	0.066	(0.064)**		0.003		(0.020)		(0.046)	
Connected to LAN	0.149**		0.081**		(0.068)**		(0.057)*		0.006	
Connected to Internet via LAN	0.138**		0.076**		(0.057)*		(0.041)		(0.006)	
Connected to Internet via telephone.	0.077**	0.047	0.065**		0.069**		0.082**		0.092**	
Percent computers not used.	(0.089)**		(-0.080)**		0.003		0.008		(0.059)*	
adj R sqd		0.315		0.227		0.110		0.101		0.111

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed

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The first outcome considered was "students are more engaged in learning due to technology." This was strongly correlated with students becoming more independent learners (simple correlation = .524), different/wider student interaction/communication (.455), developing on-line research skills (.308), and using technology in regular classrooms (.277). All of these enhance student engagement in learning. In addition, in districts where students spend more of their classroom time using computers or Internet technology, they are more engaged (correlations of .195, .233, and .231 as we move up the school levels). Finally, students are more engaged where their teachers have greater technology skills. Although there were other significant correlations, they were all smaller than .2. In sum, students who spend more time with technology, do a variety of things with it, and are guided by skilled teachers are the ones seen to be benefiting the most in regard to engagement in learning. When we entered all of these factors into a multiple regression, use in regular classrooms, different and wider interaction, and students becoming independent learners were significant, along with class time spent using technology and (inversely) with share of computers unused. The significance of variables in the regression means they have passed a much more stringent test due to the intercorrelation among the set of suggested explanatory factors. The set of independent variables explained 31.5% of the district-by-district variance in student engagement in learning.

The next outcome considered was "a deepened understanding of academic subjects due to technology in the classroom." This was strongly correlated with most of the same factors as just discussed: students becoming more independent learners (simple correlation = .451), different/wider student interaction/communication (.365), developing on-line research skills (.265), and using technology in regular classrooms (.255). In addition, student understanding is deepened when technology encourages them to do more work when not in school (.283). All of these enhance student understanding of academic subjects. In addition, in districts where students spend more of their classroom time using computers or Internet technology, they understand more (correlations of .212, .225, and .190 as we move up the school levels). Finally, students understand more when their teachers have greater technology skills. When we entered all of these factors into a multiple regression, use in regular classrooms, students becoming independent learners, and students doing more outside school work were significant, along with class time spent using technology, teacher skills in using technology, and the extent to which technology is used in student assessment efforts. The set of independent variables explained 22.7% of the district-by-district variance in student understanding of academic subjects. Again, how students use technology, time on task, and teacher skills are all-important, and indeed, more important than indicators of the amount of hardware available, proxies for which are the cost of the plan and the share of the plan already funded.

We observed fewer correlations and we were able to explain much less of the district-by-district differences in the other three outcome measures. We explained 11.1% of the variance in schools reporting students have better grades and/or test scores since they began using technology—this despite the fact that the same set of factors were associated with greater student understanding of academic subjects. Significant correlations were seen with students interacting differently and more widely (.216), students becoming independent learners (.246), and students doing more work outside class (.209). These three factors were also significant in the regression analysis. Once again time spent in class with technology was also significant in both tests, as was use of technology in student assessment efforts.

The weakest relationships were observed for the suggested outcomes of increased attendance and decreased dropouts—both of these depend on many factors besides technology use. Increased attendance was correlated with students becoming independent learners (.146) and doing more work outside school (.275). Share of class time using technology was also significant. Surprisingly, whether or not we controlled for the other suggested variable, attendance was higher on scheduled technology use days when a higher proportion of DTCs say their districts frequently use technology only in a lab. Since we believe that labs are not the best place to use technology, and indeed there is a negative correlation between use of computers in a lab and student engagement in learning, we questioned this result. However, it could be that schools and districts still relying on labs are poorer and teach students who are more prone to skip school. If the distinction among such schools is to have a computer lab or no technology at all, then it is understandable that districts making more use of labs would see an improvement in attendance. Our regression model explained only 11% of the district-by-district variation in attendance.

Finally, the weakest relationships were found regarding reduced dropout rates attributable to technology. The largest simple correlations were with students doing more schoolwork when not in school (.259), class time spent with technology, and participation in distance learning (.117). This is the only time distance learning ranked relatively high in importance. However, our full set of independent variables could explain only 10.1% of the variance in dropout rates.

These analyses have informed us in several respects. It seems that the measures of progress being made by school districts vis-à-vis technology are better able to explain more proximate student outcomes than outcomes that are further from actual classroom experiences. They explain student engagement in learning and student understanding of academic subjects more than grades, test scores, attendance, or dropping out. We can only speculate about the reasons for this. A cynic might point out that the things we can explain are subjective whereas those unrelated to our progress indicators are quantifiable. Thus, advocates of technology might be assuming that good things are happening. On the other hand, we should expect that engagement and understanding are the first things that would be changed by the proper implementation of technology, with the others being observable only after some significant time has elapsed after the introduction of technology. The truth is probably some of both of these reasons. When we do see relationships, they show that outcomes are affected by how students use the technology they have, how much time they spend with it, how well trained their teachers are, and if technology is used in assessment (i.e., they have to know how to use it to be assessed). In addition, richer technology plans and more "stuff" do not seem to affect student outcomes except through these other factors.

In order to focus on how technology use in the classroom affects student outcomes, we ran another set of regressions where independent variables were teacher uses in the classroom and student uses only (Table 28). We dropped all other variables. By including only uses, we could explain more of the district-by-district variance in student engagement in learning (adjusted R^2 increases from .314 to .377), deepened understanding of academic subjects (adjusted R^2 increases from .226 to .325), and better grades and/or test scores (from .112 to .145). The attendance and dropout outcomes remain about the same with only 10% of variance explained[16]. Table 28 reorders the outcome measures from most proximate to least proximate.

[16] For ease of exposition, we shall refer to the five outcomes as engagement, understanding, grades, attendance, and dropping out.

Table 28

Further Explanation of Student Outcomes

	Students are more engaged in learning due to technology.	Student understanding of academic subjects has deepened due to technology in the classroom.	Schools report that students have better grades and/or test scores since they began using technology.	Schools report an increase in attendance on days that students are scheduled to use technology.	Schools have reported decreases in the student dropout rate attributed to the use of technology.
Teacher use in classsroom:	**sig stdzd beta**	**sig stdzd beta**	**sig stdzd beta**	**sig stdzd beta**	**sig stdzd beta**
Integrating technology-based software into the teaching and learning process	0.194	0.143			
Expect students to turn in assignments produced with technology					
Provide inquiry-based learning projects	0.073	0.106		0.065	0.061
Meet individual student needs with help of technology	0.101	0.143	0.225	0.067	0.120
Co-operative group learning processes					
Project-based learning					
Student uses:					
Students use computers only in a lab.	0.036		0.038	0.050	
Students use technology in at least some of their regular classrooms.	0.035	0.041			-0.048
Students actively participate in distance learning with other schools.			0.062		0.090
The primary student-related use of technology is to teach students how to use the technology itself.				0.044	0.057
Students use technology to improve their basic skills with drill and practice programs.		0.035	0.062		
Students are developing online research expertise.				-0.050	
Students are interacting/communicating differently and more widely with the help of technology in the classroom.	0.120				
Students become more independent learners as a result of technology.	0.287	0.220	0.100	0.070	
Students do more schoolwork when not in school.		0.137	0.122	0.240	0.218
adj R sqd	0.377	0.325	0.145	0.095	0.094

DTCs say students are engaged in learning more frequently when they indicate technology makes students more independent learners and when they indicate teachers are integrating technology-based software into the teaching and learning process. The next strongest partial correlations with engagement are students interacting/communicating differently and more widely, teachers meet individual student needs, and teachers provide inquiry-based learning projects. Obviously, all of these require that students use technology in at least some of their regular classes, which has a lower partial correlation due to its correlation with other use variables. The simple correlations among teacher and student "use" variables appear in Appendix C.

It is interesting that DTCs describe a positive relationship between engagement and use of computers only in a lab. Computer labs are not viewed as particularly desirable today, but even in this setting there may be positive, if not optimal, effects. However, expecting students to turn in assignments produced with technology, drill and practice programs, or learning about technology itself are not significantly correlated with student engagement. On the other hand, teacher use of project-based and cooperative learning and student development of on-line research skills are not significant because they are so highly correlated with other uses.

DTCs say student understanding of academic subjects has deepened due to technology in the classroom when students become more independent learners as a result of technology, when teachers integrate technology-based software, when teachers meet individualized student needs with the help of technology, and when teacher use inquiry-based learning projects. In addition, academic understanding deepens when students do more schoolwork when not in school—more homework helps. There is also a weak but positive partial correlation between drill and practice and deepened understanding of academic subjects—practice also helps even though this is not considered an optimal use of modern technology.

It is interesting that different and wider student interaction with the help of technology appears to enhance engagement but not understanding of academic subjects. On the other hand, more mundane uses of technology, like drill and practice, or the enticement for students to do more homework, while not necessarily engaging, do deepen understanding of academic subjects.

Better grades/test scores should reflect students' deeper understanding of academic subjects. However, less than half as much of the variance (compared to engagement or understanding) in DTC views on the frequency of the grades outcome occurring can be explained by their views on the frequency of various uses of technology. Grades are most affected by individualized instruction, homework and independent learning, and less strongly by drill and practice, distance learning, and use of computers in a lab.

Since so little of the variance in attendance and dropping out can be explained by use of technology, we shall forego discussion of these.

MORE ON SYSTEM CAPACITY

By looking at differences among districts, we have identified relationships between how teachers use technology and their attitudes towards it. Additionally, teachers can influence the ways students use computers, Internet technology, and related technology, and that in turn affects how technology impacts student learning and other student outcomes. But all of this depends upon the capacity of the districts and states to support what teachers and students are doing in their schools and classrooms. That support will depend in part on how districts collect and disseminate information on technology in their schools; that is, on what districts know about their schools. It is this information aspect of system capacity to which we now turn.

We suggested five measures of technology progress that districts might track formally (Table 29). At least half the DTCs in all reporting states said "yes," they do track each of them. The most frequently tracked measures across the 21 states were "what technology is available at the schools" (95.3% said yes overall), and "the location of technology in the schools" (95.1% said yes overall). Both of these were tracked by at least 85% of districts in every participating state. It comes as no surprise that districts are most likely to be concerned with the amount of hardware that is available. But we have shown that the availability of hardware is not sufficient for effective teacher use or for positive student outcomes. Next came "how much training in technology the teachers received" (72.9% of districts said yes overall). This is a crucial factor in the success of technology initiatives, as we have shown when looking at the importance of teacher skills for student achievement. The range across the states in the proportion of districts tracking teacher training is from 98.4% of districts in North Carolina and 87% of districts in Mississippi to 54.4% of districts in Washington and 35.7% of districts in Maryland.

The two least frequently tracked indicators, still tracked by half the districts overall, were "how teachers use technology," tracked by 51.6% of districts across the 21 states, and "how students use technology" tracked in 56.5% of districts overall. In most states, between 40% and 60% of districts tracked each of these. How teachers and students actually use the available technology is at least as important as what is available, so knowing about use is very necessary. The fact that so many districts track such a wide range of technology indicators gives us confidence in the responses of DTCs throughout the survey.

We also asked about which technology progress indicators the district reports to the local school board and/or to the community (Table 30). Obviously, such reporting is necessary for gaining the interest and support of these local governing authorities. The most frequently reported indicator in all 21 states was the number of classrooms wired (reported by 71.6% of districts overall). This might be due to recent interest in the E-Rate, the popularity of NetDays around the country, the widely publicized and debated Telecommunications Bill, and the advocacy of Vice President Gore. The next most frequently reported indicator was "anecdotes about how students and teachers are using technology effectively" reported by 59.8% of all districts. Given the limited controlled research on technology's impact in the schools, anecdotes are often the most compelling support for additional funding.

Table 29 - WEIGHTED

District Tracking Policy
Percent responding yes.

	What technology is available at the schools	The location of that technology in the school	How teachers use technology	How students use technology	How much training in technology your teachers receive
Overall	95.3	95.1	51.6	56.5	72.9
Alaska	93.9	87.9	39.4	51.5	68.8
Arkansas	96.1	98.7	50.3	62.6	75.5
Delaware	93.8	87.5	43.8	50.0	66.7
Florida	92.6	85.2	53.8	57.7	74.1
Indiana	96.1	96.8	49.0	51.6	65.2
Kansas	96.6	95.1	54.5	57.9	63.4
Kentucky	98.4	95.9	49.6	53.3	83.6
Louisiana	88.9	88.9	61.1	55.6	83.3
Maryland	100.0	85.7	21.4	21.4	35.7
Minnesota	95.9	95.9	39.6	52.7	62.9
Mississippi	95.7	96.8	50.0	50.5	87.0
Missouri	100.0	100.0	52.2	43.5	78.3
North Carolina	95.3	95.3	60.9	64.1	98.4
Oklahoma	92.4	93.3	58.1	64.9	79.3
Pennsylvania	96.9	98.0	62.1	65.4	75.9
South Carolina	93.5	92.2	48.1	47.4	75.0
Utah	91.7	88.6	40.0	41.2	66.7
Washington	91.4	91.4	42.3	46.3	54.4
West Virginia	94.7	92.1	50.0	55.3	86.8
Wyoming	97.3	94.6	40.5	43.2	59.5

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Table 30 - Unweighted

Technology Progress Indicators that the District Reports to Local School Board and/or Community
Percent indicating they report indicator.

	We do not report technology progress indicators	Student to computer ratio	Number of classrooms wired	Level of teacher technological fluency	Level of student technological fluency	Anecdotes about how students and teachers are using technology effectively	Increases in motivation or engagement of students in the basic academic areas	Student performance /achievement gains	Use and effectiveness of distance learning	Increased administrative efficiencies (i.e. grading systems, attendance reporting, communicating with parents)	Increased teacher productivity	Externally funded projects	Community's use of technology	Other
Overall	19.7	55.6	71.6	27.7	24.8	59.8	25.4	34.9	18.5	47.0	23.3	47.2	28.9	2.9
Alaska	30.3	45.5	66.7	24.2	24.2	57.6	18.2	24.2	30.3	33.3	6.1	33.3	36.4	9.1
Arkansas	29.5	41.0	66.0	24.4	20.5	37.8	22.4	27.6	9.6	41.7	16.0	32.7	18.6	0.6
Delaware	18.8	50.0	75.0	43.8	18.8	62.5	25.0	31.3	6.3	37.5	18.8	56.3	12.5	0.0
Florida	11.1	77.8	81.5	11.1	7.4	63.0	40.7	51.9	22.2	40.7	29.6	44.4	18.5	0.0
Indiana	17.3	55.8	70.5	25.0	21.8	67.9	29.5	30.8	14.7	55.1	28.8	50.6	34.6	2.6
Kansas	13.7	58.9	74.7	34.2	32.2	69.2	26.7	42.5	23.3	56.2	28.1	41.8	26.7	3.4
Kentucky	4.0	92.7	94.4	25.8	25.0	70.2	31.5	43.5	22.6	55.6	26.6	54.0	29.0	1.6
Louisiana	19.4	66.7	69.4	30.6	16.7	72.2	38.9	38.9	16.7	33.3	19.4	55.6	19.4	0.0
Maryland	21.4	71.4	64.3	35.7	14.3	57.1	14.3	14.3	7.1	28.6	28.6	50.0	14.3	0.0
Minnesota	14.7	58.5	76.0	32.7	31.0	65.5	26.3	25.1	20.5	65.5	26.9	47.4	43.9	3.5
Mississippi	25.5	51.1	66.0	27.7	18.1	38.3	23.4	40.4	30.9	42.6	18.1	51.1	11.7	2.1
Missouri	17.4	78.3	82.6	21.7	26.1	69.6	17.4	47.8	13.0	52.2	30.4	73.9	47.8	13.0
North Carolina	9.4	70.3	85.9	31.3	46.9	65.6	23.4	73.4	17.2	53.1	32.8	59.4	15.6	3.1
Oklahoma	34.8	48.2	53.1	26.8	28.1	41.1	17.9	36.6	14.7	33.5	17.4	28.6	19.6	1.3
Pennsylvania	18.7	46.9	73.5	31.3	25.4	67.6	27.9	31.6	19.0	50.3	26.0	60.3	45.8	2.8
South Carolina	17.1	58.2	75.9	26.6	12.7	55.7	22.8	35.4	20.3	38.0	20.3	43.0	8.9	2.5
Utah	19.4	58.3	77.8	25.0	25.0	61.1	22.2	30.6	41.7	47.2	16.7	30.6	5.6	5.6
Washington	18.5	50.3	68.2	24.5	24.5	67.5	24.5	27.2	11.9	40.4	21.2	47.7	25.8	4.0
West Virginia	13.2	60.5	73.7	5.3	2.6	68.4	21.1	39.5	7.9	34.2	23.7	63.2	34.2	7.9
Wyoming	27.0	54.1	64.9	24.3	24.3	54.1	27.0	29.7	27.0	29.7	16.2	37.8	32.4	5.4

The third most frequently reported indicator was the student to computer ratio (55.6% of districts), followed by externally funded projects (47.2%). Given that the student/computer ratio is widely reported, it is critical that districts take great care in getting it right—by including relevant computers only, and by making sure those reporting on it understand the question. The next indicator reported, increased administrative efficiencies (i.e. grading systems, attendance reporting, communicating with parents), was reported by 47% of districts. Student performance/achievement gains was next with 34.9% reporting overall. These were the only indicators reported by at least one third of districts. Community's use of technology (28.9% reporting), level of teacher technological fluency (27.7%), increases in motivation or engagement of students in the basic academic areas (25.4%), level of student technological fluency (24.8%), and teacher productivity (23.3%) were the next group of factors reported by districts. Only 18.5% of districts reported on the use and effectiveness of distance learning, probably because distance learning is not relevant in many districts. Many of the least frequently reported indicators are the most difficult to measure, but some of these, like teacher fluency, are very important. Finally, 19.7% of districts indicated that they did not report technology progress indicators at all.

COMMUNITY CONNECTIONS (EXTERNAL SUPPORT)

In looking at the external support dimension, we are asking...Is the school-community relationship one of trust and respect, and is this translating into mutually beneficial, sustainable partnerships in the area of learning technology? We asked about the level of support for technology plans from various groups or individuals both within and outside the school district (Table 31). In districts in all states taken together, the strongest support came from the district superintendent (DTCs representing 83.2% of students rated this very high: 4 or 5 on a scale where 1= little or no support and 5 = very high support). The next strongest support came from the state department of education (80.5%). Neither of these high support rates is surprising because states participated in our survey through their departments of education, and data were provided by district offices. In 12 of 20 states, the DTCs ranked district superintendents as providing strong support more frequently than all other possible supporters, and in 5 other states, the state department of education was ranked first. In West Virginia and Maryland, the county offices of education were ranked at the top, while in Kansas principals were said to be the most supportive.

The top two support groups were followed by students (DTCs representing 72.1% of students rated them 4 or 5), school boards (72%), principals (68.8%), teachers (63.6), parents (59.4%), business community (58.8%), software/hardware companies (57.4%), regional educational service agencies (56.4%), county office of education (55.5%), and telecommunication companies (53.1%). All of these entities were ranked by DTCs in a majority of districts as being very supportive of district technology plans. It is interesting that the bottom four in level of support were teachers' associations (44.8%), local post-secondary institutions (43.5%), foundations (38.8%), and community groups (36%). Clearly support for district technology plans is strongest from internal groups rather than outside interests.

Table 31 - Weighted

Level of Support for Technology Plan by the Following Groups

Percent 4 and 5 on a scale in which 1 is "Little or None" and 5 is "Very High."

	Principals	Teachers	Teachers' association	Parents	School Board	Superintendent	Students	Business community	Software/ hardware companies	Telecommunications companies	Local post-secondary institutions	Community groups	Foundations	State Depart-ment of Education	County Office of Education	Regional educational service agencies
Overall	68.8	63.6	44.8	59.4	72.0	83.2	72.1	58.8	57.4	53.1	43.5	36.0	38.8	80.5	55.5	56.4
Alaska	41.7	24.7	22.6	33.2	83.5	96.7	45.4	26.5	88.3	90.2	91.2	37.7	23.4	78.7	74.4	53.0
Arkansas	74.4	65.7	32.3	55.7	77.8	90.8	67.1	51.5	40.0	34.1	40.6	28.2	20.0	57.8	5.3	47.7
Delaware	54.6	34.2	25.7	46.2	54.3	60.6	53.6	36.4	30.3	18.0	29.2	6.3	6.3	44.1	0.0	7.5
Florida	55.9	49.4	34.7	44.8	58.5	65.6	62.7	58.5	52.4	50.5	27.3	20.8	49.8	96.5	66.9	49.1
Indiana	69.8	69.6	50.7	45.3	75.0	87.9	60.5	41.9	34.0	27.8	24.1	22.4	34.8	68.4	14.2	54.3
Kansas	88.2	80.9	48.8	81.1	83.2	85.9	82.9	68.8	45.0	45.2	34.3	33.0	33.6	66.4	21.4	41.8
Kentucky	73.1	66.5	35.4	62.1	72.9	83.3	84.2	53.1	34.7	35.0	24.7	23.7	19.5	93.8	74.2	70.3
Louisiana	86.9	84.8	77.9	84.0	86.4	94.5	64.0	51.8	71.6	77.1	73.1	65.9	41.3	91.2	71.4	63.4
Maryland	5.0	57.0	38.8	60.0	13.2	12.6	61.3	59.3	45.3	39.3	37.6	51.9	5.8	49.4	79.2	11.9
Minnesota	82.6	80.5	65.3	78.4	93.1	94.9	79.4	63.6	50.9	52.2	49.0	48.5	46.4	57.0	29.2	60.4
Mississippi	58.6	57.1	22.4	50.3	76.0	82.4	70.2	46.4	53.6	60.8	44.7	30.2	20.0	93.4	56.5	42.4
Missouri	89.4	88.6	60.9	67.3	92.6	92.6	75.2	72.5	34.2	43.3	41.2	42.5	41.6	69.7	3.8	12.2
North Carolina	68.2	63.5	45.6	67.5	68.9	77.3	82.3	64.8	74.8	73.5	70.3	54.2	50.2	89.2	68.7	56.3
Oklahoma	82.1	58.3	48.5	72.2	87.3	92.6	62.8	71.2	53.3	55.2	49.0	32.9	36.9	77.6	9.6	16.7
Pennsylvania	70.9	56.2	42.8	56.5	78.7	92.8	86.5	64.1	60.7	58.6	47.9	36.6	42.0	83.8	57.4	69.8
South Carolina	83.8	81.7	51.1	57.6	77.0	96.1	81.3	61.6	58.3	56.5	55.5	39.5	36.8	89.8	66.3	66.4
Utah	78.4	78.4	46.9	74.5	68.5	81.0	33.8	35.3	80.4	46.5	31.6	45.1	66.1	98.5	55.7	42.0
Washington	57.2	45.5	34.0	38.4	62.5	69.4	46.1	68.4	68.1	42.3	28.5	17.5	24.9	43.4	30.0	56.0
West Virginia	79.3	60.2	44.0	73.7	71.3	92.4	82.3	57.9	39.5	57.3	21.7	16.4	16.1	89.6	99.4	69.0
Wyoming	69.5	60.3	35.5	52.7	66.7	87.2	63.6	32.3	18.0	14.6	9.0	27.9	8.3	74.9	10.0	30.5

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How important are the levels of support from different constituencies and leaders in school districts? We hypothesized that where support for a technology plan from the superintendent, principals, school boards and teachers was stronger, more would get done. The measures of progress selected to test this hypothesis were the ratio of students to computers available for student use which are capable of accessing the Internet, and the percent of the district technology plan that has been fully funded to date. With greater support, the student/computer ratio should be lower and the percent fully funded should be higher.

Table 32 shows that there is almost perfect correlation between support from the superintendent and progress, a negative correlation of -.935 with the student/computer ratio, and a positive correlation of .992 with percent funded. The relationship between teacher support and progress is almost as strong with correlations of -.848 and .938 with the student/computer ratio and percent funded respectively. Support from principals is somewhat less related to progress (correlations of -.287 and .834); and support from school boards has the weakest correlation to progress of the four (a *positive* correlation with the student/computer ratio of .111 and a correlation of .541 with percent of plan funded). These findings underline the importance of system capacity and particularly leadership and teacher support in getting district technology plans successfully implemented.

Table 32

Relationship between Support Levels and Progress

Level of Support From:	Little or none				Very high	Correlation between level of support and ...
Superintendent	**1**	**2**	**3**	**4**	**5**	
number of students	4,189	11,885	4,836	4,452	4,277	-0.3436
student/computer ratio	85.9	56.2	46.2	42.6	31.9	-0.9350
percent of plan funded	29.6	31.8	37.0	41.1	46.5	0.9923
Teachers	**1**	**2**	**3**	**4**	**5**	
number of students	2,671	7,772	4,490	3,955	4,939	0.0604
student/computer ratio	53.1	59.4	34.6	37.5	30.3	-0.8484
percent of plan funded	29.0	38.7	40.7	45.7	46.1	0.9381
Principals	**1**	**2**	**3**	**4**	**5**	
number of students	2,896	7,257	6,120	4,865	3,552	0.0952
student/computer ratio	31.6	55.3	42.0	38.9	30.8	-0.2867
percent of plan funded	38.9	39.0	38.1	45.6	45.8	0.8337
School Board	**1**	**2**	**3**	**4**	**5**	
number of students	2,340	6,439	4,972	3,704	4,817	0.2292
student/computer ratio	18.8	51.7	44.5	40.0	29.2	0.1109
percent of plan funded	43.2	33.1	35.6	43.2	49.3	0.5407

External support from community groups may be influenced by involvement of parents and other members of the community in the technology-related activities of the schools. Since support from community groups was the lowest of any in or out of education group, we now turn to community involvement. We suggested five ways this might occur, and DTCs indicated that none of them occur very frequently (Table 33). Overall, the modal response was 2 or 1 on a 1 to 5 scale, where 1= never and 5= frequently. "Parents and teachers can communicate via email" occurred frequently (i.e., 4 or 5) according to DTCs representing 19% of students overall. The next most frequent response was "students have access to technology in schools during non-school hours" (17.7%). "Community has access to technology in schools during non-school hours" at 15.3% was the next most frequently reported, followed by "school staff provides support to community members for their technology needs" with 11.3%, and the last reported use was "students provide support to community members for their technology needs" at 7.1%. Apparently, if schools want more community support for their technology efforts, they must involve parents and the broader community in their technology activities to a much greater degree than they do now.

Table 33 - Weighted

Extent to Which the Following Uses of Technology Occur in District
Percent 4 and 5 on a scale in which 1 is "Never" and 5 is "Frequently."

	Community has access to technology in schools during non-school hours.	Students have access to technology during non-school hours.	School staff provides support to community members for their technology needs.	Students provide support to community members for their technology needs.	Parents and teachers can communicate via email.
Overall	15.3	17.7	11.3	7.1	19.0
Alaska	23.5	25.0	4.7	18.2	28.5
Arkansas	6.3	6.3	8.0	2.8	19.5
Delaware	4.9	19.4	0.0	0.0	1.4
Florida	5.7	9.8	2.2	0.0	0.3
Hawaii	100.0	100.0	100.0	100.0	100.0
Indiana	17.1	16.2	14.3	8.0	19.5
Kansas	11.7	28.7	13.6	6.1	26.7
Kentucky	22.6	24.9	18.5	13.2	28.4
Louisiana	4.8	19.6	0.7	0.0	6.8
Maryland	2.0	5.5	2.9	2.1	13.6
Minnesota	22.0	25.9	15.1	8.6	23.1
Mississippi	14.2	13.1	6.9	3.1	12.8
Missouri	34.7	47.7	32.9	19.3	35.2
North Carolina	3.6	7.0	15.4	2.4	11.5
Oklahoma	14.1	16.0	16.3	6.3	10.3
Pennsylvania	22.1	18.7	12.1	3.7	13.6
South Carolina	13.6	16.3	8.3	5.0	18.6
Utah	4.6	7.1	0.4	10.0	50.8
Washington	16.7	22.6	8.7	6.1	36.3
West Virginia	21.5	12.4	12.4	9.7	11.7
Wyoming	38.2	31.6	26.9	18.4	8.4

Beyond the moral support just discussed, we asked about funding or contributing in-kind goods and services from various government and non-government sources (Table 34). Unsurprisingly, most districts used state funds across our 21 states (DTCs representing 86.6% of students). Other governmental funding came from district general funds (73.8%), federal funds (63.7%), and district categorical funds (63.6%). Significantly behind were use of local bonds (28.5%), regional educational service agencies (17.6%), and state bonds for technology (8.4%).

Table 34 - Weighted ***Sources of Funding or In-kind Goods and Services for Technology to Date***

	Governmental								Non-Governmental									
	State funds	State bonds	Federal funds	District categorical funds for technology	District general funds	Local bonds	Regional educational service agencies	Other	Teachers' association	Software/ hardware companies	Telecommunications companies	Other businesses	School fund-raising	Parents	Local post-secondary institutions	Community partnerships	Foundations	Other
Overall	86.6	8.4	63.7	63.6	73.8	28.5	17.6	6.8	2.1	32.0	29.3	33.1	58.3	48.3	12.2	35.8	32.6	2.6
Alaska	91.3	0.0	89.7	84.4	96.1	33.6	16.9	8.4	0.0	29.1	36.3	21.8	89.9	76.5	12.9	76.6	20.2	0.7
Arkansas	41.9	0.0	66.5	44.3	83.2	7.0	8.7	7.7	0.6	11.3	7.5	28.1	48.3	26.3	5.2	7.4	7.9	13.9
Delaware	73.0	3.0	67.9	52.1	70.4	0.0	11.2	0.0	3.5	0.0	1.8	34.4	65.0	35.2	10.7	39.5	6.8	0.0
Florida	100.0	0.0	57.0	58.3	53.8	19.1	29.3	0.7	0.0	49.8	36.3	50.9	60.5	53.8	21.0	36.6	36.7	0.0
Indiana	75.2	15.3	38.0	71.8	52.6	18.7	18.0	7.8	5.4	19.5	16.1	11.2	42.5	20.8	4.1	15.0	28.9	1.4
Kansas	68.9	0.0	47.2	46.5	85.0	38.8	6.6	0.0	1.6	7.2	24.2	17.6	43.4	37.6	0.4	9.6	23.5	1.0
Kentucky	96.6	1.0	79.2	64.5	96.8	7.9	7.4	11.2	1.0	33.1	23.6	32.8	74.6	43.8	11.3	27.8	21.1	6.5
Louisiana	99.0	0.9	99.3	70.3	92.9	11.6	24.9	8.4	0.0	47.6	40.1	40.3	58.3	76.2	21.9	63.6	41.4	1.1
Maryland	68.6	0.0	50.1	59.2	62.1	0.0	3.3	5.8	0.0	37.3	31.4	11.6	45.7	41.7	0.9	71.7	5.8	0.0
Minnesota	74.2	1.0	44.7	85.8	77.2	47.4	6.9	6.7	0.8	8.8	14.6	20.4	49.3	46.4	3.4	29.0	33.8	4.2
Mississippi	90.7	10.2	65.7	60.1	75.5	14.0	8.4	8.7	1.4	13.4	23.4	25.8	64.9	42.6	6.8	30.8	23.2	2.5
Missouri	97.0	0.0	69.1	92.4	89.8	50.2	8.8	1.9	3.5	16.1	27.1	20.1	68.2	42.6	15.7	29.3	43.1	2.4
North Carolina	100.0	22.1	82.8	46.5	68.7	36.2	7.9	8.6	1.0	42.7	34.9	32.1	72.9	63.8	21.0	49.0	23.8	6.2
Oklahoma	26.6	0.3	64.6	16.7	87.9	58.4	12.4	3.8	0.6	4.8	10.7	32.4	47.9	46.3	15.3	30.2	33.5	3.6
Pennsylvania	93.0	16.9	70.9	76.3	76.6	39.5	21.3	3.6	4.7	30.7	27.2	26.9	46.6	39.6	20.7	30.4	29.1	3.0
South Carolina	94.2	6.8	58.4	65.3	88.1	33.3	9.5	1.2	2.4	9.1	34.1	29.6	71.9	55.7	4.4	28.3	34.2	0.4
Utah	100.0	0.1	38.7	91.6	66.0	29.3	1.8	3.9	0.0	18.1	28.3	46.9	77.1	55.7	10.5	29.5	56.0	2.8
Washington	79.2	0.4	61.7	68.1	90.7	46.8	13.9	29.0	7.8	55.7	31.0	28.4	37.9	39.2	2.5	31.7	32.9	1.9
West Virginia	92.6	1.6	59.6	67.6	89.7	31.7	52.0	13.8	0.0	61.6	42.0	59.3	89.8	53.6	8.7	46.6	43.2	4.6
Wyoming	63.9	0.0	54.3	47.5	91.5	37.7	5.0	6.3	0.0	19.5	10.1	27.3	46.9	40.8	7.4	48.0	52.4	6.4

Among non-governmental sources, districts relied upon school fundraising (58.3%), parents (48.3%), community partnerships (35.8%), other businesses (33.1%), foundations (32.6), software/hardware companies (32.0%), telecommunications companies (29.3%), local post-secondary institutions (12.2%), and teachers' associations (2.1%). Other than parents and school fundraising, which usually depends mostly on parents, districts have a long way to go to tap all possible financial resources for their technology efforts. It is likely that support from business is concentrated in relatively few districts.

The relatively high frequency of financial or in-kind contributions of community partnerships leads us to inquire about the types of partnerships that focus on school technology being forged with business or other organizations (Table 35). The most frequent partnerships were with software/hardware companies (districts representing 42.5% of students in all our states indicated their districts had such partnerships). This was followed by partnerships with local colleges and universities that occurred in districts representing 41.6% of students. These probably involved the training of teachers. Next, DTCs representing 39.9% of students indicated their districts had partnerships with telecommunications companies. Less frequent partnerships occurred with foundations (31.5%), regional educational service agencies (30.9%), local non-technology businesses (30.2%), community groups (27.3%), and professional organizations (15.8%). Again, we see many opportunities for districts to expand their outreach activities.

Table 35 - Weighted

Schools in District that Have Formal Partnerships that Focus on School Technology
Percent indicating they have partnership.

	Software/ hardware companies	Telecom-munications companies	Local non-technology business	Community groups	Foundations	Professional organiza-tions	Local colleges/ universities	Regional educational service agencies	Other
Overall	42.5	39.9	30.2	27.3	31.5	15.8	41.6	30.9	3.7
Alaska	78.1	83.2	63.3	17.2	15.6	16.2	24.9	4.4	14.2
Arkansas	19.1	17.8	2.8	7.0	1.5	2.3	12.9	17.6	2.0
Delaware	13.3	6.3	35.4	0.0	16.6	0.0	6.2	5.0	4.1
Florida	80.4	76.2	41.7	46.2	76.4	28.3	77.4	41.8	1.2
Hawaii	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
Indiana	23.5	23.1	18.7	11.1	13.5	5.6	31.9	38.1	3.4
Kansas	12.6	18.7	6.1	2.9	3.4	0.6	15.0	13.4	5.8
Kentucky	13.0	15.1	23.3	12.6	12.5	7.5	22.1	26.7	1.3
Louisiana	30.6	33.9	42.5	35.6	36.0	7.8	39.3	38.2	3.5
Maryland	43.7	31.4	52.9	45.3	18.6	44.3	88.2	36.9	0.0
Minnesota	38.5	29.5	19.3	25.9	35.1	15.6	26.9	39.1	6.1
Mississippi	9.8	27.5	14.0	18.3	7.8	5.7	23.2	17.2	2.5
Missouri	16.6	24.9	8.5	26.5	16.4	1.3	14.9	12.6	1.8
North Carolina	31.4	50.5	30.4	34.8	18.4	5.4	75.8	18.8	0.8
Oklahoma	22.5	30.1	26.1	18.6	4.3	0.8	13.7	1.3	7.3
Pennsylvania	45.0	47.4	30.8	32.6	31.1	27.9	44.4	35.8	6.7
South Carolina	23.3	25.2	17.6	20.6	15.2	3.2	20.6	11.6	4.0
Utah	48.1	29.5	45.5	8.9	46.8	2.8	23.6	18.3	0.0
Washington	64.0	24.7	14.0	11.1	25.4	6.2	16.4	34.6	7.9
West Virginia	38.0	35.4	25.8	15.2	25.4	5.2	21.1	62.7	0.0
Wyoming	58.5	17.2	26.4	41.1	31.8	6.2	60.0	42.5	6.6

CONCLUSION

Districts around the country clearly have made progress toward fully implementing technology in their schools. This report indicates where districts in the 21 states that had 40% or higher response rates to the Milken Exchange State-by-State Survey stand regarding a number of technology progress indicators suggested by the Exchange's seven dimensions for gauging progress. Hopefully, the report also provides insights as to where extra effort is needed. In subsequent years, follow-up reports will enable those interested in school technology to see what progress has been made.

We also have been able to identify relationships among various measures of the progress of districts regarding their technology. Differences in the extent to which teachers in various districts use technology in the classroom can explain 18.3% of the differences in teacher attitudes toward technology in different districts. Those who make better use of it recognize its power more. Those who use it less are more likely to feel technology is just another fad being mandated from above.

We also tried to explain teacher attitudes toward technology by total hours of technology training, the availability of training incentives, the district technology plan's cost per student per year and percent of the district plan that has been funded. These, along with the extent to which teachers use technology in their own practice, as distinguished from classroom use, explained very little of the attitudinal differences—12.3% to be precise. This is less than what was explained by measures of the use of technology in the classroom. Clearly, when teachers use technology in the classroom they develop more positive attitudes about it, and such use is the most important way to prove its value to teachers.

One of the most valuable results of our survey was the identification of correlates of desired student outcomes. We were able to explain between 10% and 31% of the district-by-district variance in the frequency of occurrence of the outcomes, depending upon which outcome we look at. The measures of progress being made by school districts vis-à-vis technology are better able to explain more proximate student outcomes than outcomes that are further from actual classroom experiences. They explain student engagement in learning and student understanding of academic subjects more than grades, test scores, attendance, or dropping out. When we do see relationships, they show that outcomes are affected by how students use the technology they have, how much time they spend with it, how well trained their teachers are, and if technology is used in assessment (i.e., they have to know how to use it to be assessed). In addition, richer technology plans and more "stuff" do not seem to affect student outcomes except through these other factors.

A recent study of the relationship between different uses of education technology and various educational outcomes by Harold Wenglinsky of the Educational Testing Service has received a great deal of publicity lately[17]. The attention given to the Wenglinsky study can be attributed in part to the fact that it was commissioned by *Education Week* and reported on by that publication in its annual review issue on technology (funded by the Milken Exchange). Although the findings of the study were mixed, technology advocates seized upon the positive results to counter charges that there is little evidence that technology works. Although this is neither the only study nor the best one available, we will discuss it briefly because it is current and because of the widespread discussion it has evoked.

[17] Wenglinsky, Harold. *Does it Compute?* Princeton: Educational Testing Service, 1998.

Wenglinsky's study has a purpose similar to that of our survey of DTCs as both attempt to explain student outcomes by technology use. Any comparisons are rather indirect however, because our outcomes are engagement in learning and deepening understanding of academic subjects, whereas his are NAEP score improvement and social environment of the school. Also, Wenglinsky looks at 4th and 8th graders specifically and uses individuals as the unit of observation. We get our data from reports of DTCs on their districts as a whole. Despite the differences, some comparisons are still possible. We will state Wenglinsky's finding and follow it with related results from our own study (in Italics).

- ✔ Teachers' professional development in technology and the use of computers to teach higher-order thinking skills were both positively related to academic achievement in mathematics and the social environment of the school. *Our study found that where DTCs indicated teachers had more technology training, where there were incentives for teachers to get more of such training, and where teachers had higher technology skills, they also indicated students were more engaged in learning due to technology and that student understanding of academic subjects has deepened due to technology in the classroom.*

- ✔ Wenglinsky finds that frequency of school technology use is negatively related to achievement. *Our study finds a significant and positive relationship between percent of classroom time spent using computers and both student engagement in learning and their deepening understanding of academic subjects. Wenglinsky controls for the way computers are used and then looks at the effects of time spent net of that. We include both class time spent using computers and various ways students use them in the same regression model. Although the two approaches seem similar, the results are different.*

- ✔ The use of computers to teach lower-order thinking skills was negatively related to academic achievement and the social environment of the school. *Our study does report a weak but positive relationship between drill and practice and deeper understanding of academic subjects. This may be due to differing interpretations of what "drill and practice" means.*

- ✔ Using computers for learning games was positively related to academic achievement and the social environment of the school. It is not obvious what use of computers for learning games really means. Some might believe that certain learning games are another way of doing drill and practice. By increasing the tendency of teachers to use computers for learning games, professional develompent of teachers was also positively related to academic achievement and the social environment of the school. The size of the relationships between the various positive uses of technology and academic achievement was negligible for fourth-graders, but substantial for eighth-graders. For fourth-graders, professional development and using computers for learning games each contributed about a tenth of a grade level of academic achievement, or the equivalent of a few weeks of instruction. For eighth-graders, however, professional development and using computers for higher-order thinking skills were each associated with more than a one-third of a grade level increase. *In our study, students are also reported to be more engaged and to have a deeper understanding of academic subjects where students are reported to be using technology in at least some of their regular classrooms, becoming more independent learners, and developing on-line research expertise, and where teachers are reported to be providing inquiry-based learning projects, to be doing more individualized instruction, and to be integrating technology-based software into the teaching and learning process. These student and teacher uses probably reflect the positive uses of technology referred to by Wenglinsky as use for higher order thinking skills.*

Finally, our analyses underline the value of the Milken Exchange's "Seven Dimensions" framework for understanding the dynamics and progress of technology in America's schools. We have seen how the learning environment impacts student outcomes. It is clear that support from district leadership is vital for progress to be made in implementing school technology. We have confirmed the importance of teacher professional development in providing them the skills necessary to succeed in using modern technology.

All of this depends upon the quality of the information available from which we can understand the state of technology in America's schools today. This study has demonstrated the difficulty in obtaining high quality data, for example the different conclusions that can be drawn depending upon one's definition and measurement of the student/computer ratio. But we are left optimistic about what we know, about where we are, and about the good things that will happen to students when we get where we want to be.

APPENDIX A

Milken Exchange on education technology

Dear District Technology Coordinator,

It is important to get timely education technology data that are accurate and comparable across states. The Milken Exchange on Education Technology, in cooperation with the state technology directors, has prepared a brief survey to be completed by district technology coordinators. The responses will be collected and tabulated by the Milken Exchange.

The Milken Exchange was established in 1997 to advance a compelling national agenda for education through five key strategies: increasing public awareness; advancing public policy; supporting new designs for teaching and learning; building capacity of schools through planning; and reflecting and acting on research and practice.

This project could play a key role in the success of school technology in your state. If we can show that schools have changed for the better when they use technology properly—and that test score gains are not the only measure of improvement—this will help secure future support and funding. We believe that the selected questions will provide a good picture of the status of technology in our nation's schools; and it includes questions that are important but often not asked.

As you answer the enclosed survey questions, please remember that it is a survey of *districts* rather than of individual schools. Thus please reply with reference to the "typical" school, classroom, teacher or student in your district, even though we recognize that there can be significant variance in levels of technology within a district. We are *not* asking districts to survey their schools; we are seeking the views of and information from the district technology coordinators themselves.

In the very largest districts we have asked the state technology directors to send surveys to regional technology coordinators within the districts as well as to the district technology coordinator. If you are one of the regional technology coordinators in a large school district, please respond for your region only.

It is vitally important that we get a very high response rate from districts so that we can provide an accurate picture of school technology in your state. We urge you to complete the survey either in paper form and return it in the accompanying envelope, or over the web by accessing **http://www.milkenexchange.org/pilot/**.

PLEASE RETURN YOUR COMPLETED QUESTIONNAIRE BY MAY 7TH.
The survey should take under one hour to complete.

If you have questions, please contact Dr. Tamara Schiff of the Milken Family Foundation at 310-998-2686 or email her at tschiff@mff.org. Thank you for your participation in this valuable data collection project.

Sincerely,

Lewis C. Solmon
Senior Vice President and Project Director

MILKEN EXCHANGE ON EDUCATION TECHNOLOGY
Survey of Technology in the Schools

We are interested in the perceptions of district technology coordinators. Please respond with reference to the "representative" school in your district, and refer to the "typical" classroom in that school. We have separated our questions according to categories in a framework of Progress Indicators developed by the Milken Exchange in collaboration with the state technology directors.

Your name: ______________________________

Title: ______________________________

School district: ______________________________

Mailing address: ______________________________

City: ______________________________ State: ________ Zip: ____________

Phone: ________________ Fax: ____________ Email: ________________

How many schools are in your district? Number ____________

How many students are in your district? Number ____________

If you are responding for a school rather than a district, please indicate if your school is a : (Mark one only.)

☐ Charter school ☐ Parochial school ☐ Independent school ☐ Public school

☐ Other, please specify ....

LEARNERS/LEARNING ENVIRONMENTS

1 Please indicate how frequently each of the following occur in schools in your district: (Check frequency for each item.)

Student Use	SCALE:	NEVER 1	2	3	4	ALMOST ALWAYS 5	DON'T KNOW 6
Students use computers only in a lab.							
Students use technology in at least some of their regular classrooms.							
Students actively participate in distance learning with other schools.							
The primary student-related use of technology is to teach students how to use the technology itself.							
Students use technology to improve their basic skills with drill and practice programs.							
Students are developing online research expertise.							
Students are interacting/communicating differently and more widely with the help of technology in the classroom.							
Students become more independent learners as a result of technology.							
Students do more school work when not in school.							

Student Outcomes	SCALE:	NEVER 1	2	3	4	ALMOST ALWAYS 5	DON'T KNOW 6
Students are more engaged in learning due to technology.							
Student understanding of academic subjects has deepened due to technology in the classroom.							
Schools report an increase in attendance on days that students are scheduled to use technology.							
Schools have reported decreases in the student dropout rate attributed to the use of technology.							
Schools report that students have better grades and/or test scores since they began using technology.							

Teacher Use	SCALE:	NEVER 1	2	3	4	ALMOST ALWAYS 5	DON'T KNOW 6
Curricula are enhanced by integrating technology-based software into the teaching and learning process.							
Teachers expect that students turn-in class assignments produced with technology *(i.e., word processing, email, spreadsheets)*.							
Teachers use technology to provide more inquiry-based learning projects.							
Teachers adjust their teaching practices to meet individual student needs with the help of technology.							
Teachers use cooperative group learning processes.							
Project-based learning takes place.							

2 What percentage of student classroom time per week is spent using computers or Internet technology? (Check percentage for each item.)

	SCALE:	0%	1-5%	6-20%	21-40%	41-60%	MORE THAN 60%
Elementary schools							
Middle schools							
High schools							

3 On average, how many queries per week from teachers or schools in your district does your office receive regarding the planning and implementation of technology?

Number of queries: ____________

4 In general, where do teachers in your district fall on a scale in which 1 indicates that "they believe technology is just another fad being mandated by those above them" and 5 is "a powerful tool for helping them improve student learning"?

SCALE:	MANDATED FAD 1	2	3	4	VALUABLE TOOL 5

PROFESSIONAL COMPETENCY

5 **A) *On average*, how many hours of technology training has a typical teacher in your district received in the last year?**
(Note: The same training can enhance more than one skill; so if, for example, a ten hour course provides training in both software applications and Internet use, enter 10 for both.)

B) How would you rate the skill level of your typical teacher on a scale of 1 to 5 where 1 is beginner and 5 is advanced?

(Indicate hours and rating for each item.)	HOURS OF TRAINING OVER PAST 12 MOS.	SKILL LEVEL SCALE: BEGINNER 1	2	3	4	ADVANCED 5
Computer use	______					
Software applications	______					
Internet use	______					
Multimedia peripherals	______					
Online projects	______					
Using distance learning equipment and infrastructure	______					
Integrating technology into instruction	______					
Using email	______					
Other, please specify	______					
Total hours of technology training for the typical teacher *(not the sum of the above)*	______					

6 **To what extent are teachers in your district using technology in their own practice?** (Check extent for each item.)

	SCALE: NOT AT ALL 1	2	3	4	VERY MUCH 5
Administrative work/classroom management *(e.g. grade/attendance recording)*					
Communicating with colleagues					
Accessing experts					
Accessing training					
Using simulations when teaching science					
Using desktop publishing to teach writing					

SYSTEM CAPACITY

7 **Does your district formally keep track of:**

	YES	NO
What technology is available at the schools.	☐	☐
The location of that technology in the schools.	☐	☐
How teachers use the technology.	☐	☐
How students use the technology.	☐	☐
How much training in technology your teachers receive.	☐	☐

8 **How frequently does your district evaluate technology use in your schools?**

☐ More than once a year ☐ Yearly ☐ Less frequently than yearly ☐ Never

9 **To what extent is technology used in student assessment efforts in your district?**

SCALE:	NEVER 1	2	3	4	FREQUENTLY 5

10 **Are teachers in your district given incentives for acquiring technological fluency and/or for changing their teaching methods to take advantage of the available technology?** YES ☐ NO ☐ (If no, skip to question 12.)

11 **What incentives does your district provide for teachers who use technology?**

	YES	NO
Salary supplement	☐	☐
Mentor teacher designation *(or similar designation)*	☐	☐
Participation in special workshops	☐	☐
Release time	☐	☐
Additional resources for their classroom	☐	☐
Positive evaluations	☐	☐
School or district recognition program	☐	☐
Free or discounted computers for their own use	☐	☐
Free software	☐	☐
Other, please specify	☐	☐

12 **What technology progress indicators does your district report to the local school boards and/or community?** (Mark all that apply.)

☐ *We do not report technology progress indicators*

☐ Student to computer ratio

☐ Number of classrooms wired

☐ Level of teacher technological fluency

☐ Level of student technological fluency

☐ Anecdotes about how students and teachers are using technology effectively

☐ Increases in motivation or engagement of students in the basic academic areas

☐ Student performance/achievement gains

☐ Use and effectiveness of distance learning

☐ Increased administrative efficiencies *(i.e., grading systems, attendance reporting, communicating with parents)*

☐ Increased teacher productivity

☐ Externally funded projects

☐ Community's use of technology

☐ Other, please specify

EXTERNAL SUPPORT

13 Please indicate the level of support (i.e. encouragement, advocacy) for your technology plan by the following groups:
(Check level of support for each item.)

SCALE:	LITTLE OR NONE 1	2	3	4	VERY HIGH 5
Principals					
Teachers					
Teachers' association					
Parents					
School board					
Superintendent					
Students					
Business community					
Software/hardware companies					
Telecommunications companies					
Local post-secondary institutions					
Community groups					
Foundations					
State department of education					
County office of education					
Regional educational service agencies					

14 From where has the district and its schools obtained the funds or in-kind goods and services for technology to date?
(Mark all that apply.)

Governmental

- ☐ State funds, please specify ....
- ☐ State bonds
- ☐ Federal funds, please specify ....
- ☐ District categorical funds for technology
- ☐ District general funds
- ☐ Local bonds
- ☐ Regional educational service agencies
- ☐ Other, please specify ....

Non-Governmental

- ☐ Teacher's association
- ☐ Software/hardware companies
- ☐ Telecommunications companies
- ☐ Other businesses
- ☐ School fund-raising
- ☐ Parents
- ☐ Local post-secondary institutions
- ☐ Community partnerships
- ☐ Foundations
- ☐ Other, please specify ....

15 To what extent do the following uses of technology occur in your district? (Indicate extent for each item.)

SCALE:	NEVER 1	2	3	4	FREQUENTLY 5
Community has access to technology in schools during non-school hours					
Students have access to technology during non-school hours					
School staff provides support to community members for their technology needs					
Students provide support to community members for their technology needs					
Parents and teachers can communicate via email					

16 Do schools in your district have formal partnerships that focus on school technology with any of the following groups?
(Mark all that apply.)

- ☐ Software/hardware companies
- ☐ Telecommunication companies
- ☐ Local non-technology business
- ☐ Community groups
- ☐ Other, please specify ....
- ☐ Foundations
- ☐ Professional organizations
- ☐ Local colleges/universities
- ☐ Regional educational service agencies

TECHNOLOGY CAPACITY

17 Does your district have a formal technology plan? (Check one.)

- ☐ Yes, we have a formal plan.
- ☐ No, we are in the process of developing a plan.
- ☐ No, we do not have a formal district technology plan.
  (Note: If you do not have a formal technology plan, please skip question 18 and answer questions 19-23 with your best estimates.)

18 How many years are covered in your district technology plan? ____________ years

19 Based upon your district technology plan, what do you think the total cost of implementing technology properly and fully in your district would be for the number of years noted in the previous questions? (Do not reduce your estimate by the discount expected from the E-Rate.) $ ____________

20 Of these costs, how much do you expect to be reduced by the E-Rate? $ ____________

21 What percent of your district technology plan has been fully funded to date?
(Include the value of donated goods and services.) ____________ %

22 What percent of your district budget currently goes toward technology (hardware, software, infrastructure, technical support, training)?

Percent of capital budget ____________ %
Percent of operating budget ____________ %

23 In your district, what is the ratio of students to computers available for student use which are capable of accessing the Internet?
(Note: These computers can be in classrooms, labs, library media centers or any other location with student access.)

# of students to each computer ____________

24 What percentage of schools in your district has the majority of its classrooms: (Check percentage for each item.)

SCALE:	0%	1-25%	26-50%	51-75%	MORE THAN 75%
Connected to a local area network (LAN)					
Connected to the Internet via the LAN					
Connected to the Internet via direct telephone line					

25 **When technology at schools in your district breaks down (i.e. computer freezes, printer jams, no connection to the Internet), how long does it typically take to fix the problem?**

________ hours or # ________ days

26 **In general, how frequently do each of the following provide technical support or maintenance for technology in the schools in your district?** (Check frequency for each item.)

	NEVER	OCCASIONALLY	FREQUENTLY
Classroom teachers			
Library media teacher			
Other school staff hired specifically for those purposes *(including computer lab teachers, computer aids)*			
Other school staff with additional responsibilities			
District providers on contract or as needed			
Commercial providers on contract or as needed			
Students			
Regional educational service agencies			
Other, please specify			

27 **What percent of computers at schools in your district are not used?** (If zero, skip to question 29.)

SCALE:	0	1-10%	11-25%	26-50%	51-75%	OVER 75%

28 **Please indicate how important a factor each of the following is in explaining why these computers are not used.** (Check importance for each item.)

SCALE:	NOT IMPORTANT 1	2	3	4	VERY IMPORTANT 5
Teachers are not trained to use them					
Classrooms do not have the appropriate wiring					
No interest					
Too many other computers					
Outdated computers					
Computers require repair					
No appropriate software					
Need to revise curriculum					

29 **Approximately what percentage of schools in your district have directly benefited from Federal funds or discounts?** (Check percentage for each item.)

SCALE:	0	1-10%	11-25%	26-50%	51-75%	76-99%	100%
TLCF							
E-Rate							
Other, please specify							

30 **Please provide a description of your duties and responsibilities in the district:**

Survey of Technology in the Schools

Weighting Scheme for 1998 Data Collection

Number of schools in district	Unweighted
Number of students in district	Unweighted
Type of schools if other than public	n/a
Question 1	Weighted
Question 2	Weighted
Question 3	Unweighted
Question 4	Weighted
Question 5	Weighted
Question 6	Weighted
Question 7	Unweighted
Question 8	Unweighted
Question 9	Weighted
Question 10	Weighted
Question 11	Weighted
Question 12	Unweighted
Question 13	Weighted
Question 14	Weighted
Question 15	Weighted
Question 16	Weighted
Question 17	Unweighted
Question 18	Unweighted
Question 19	Unweighted
Question 20	Unweighted
Question 21	Unweighted
Question 22	Unweighted
Question 23	Weighted
Question 24	Weighted
Question 25	Weighted
Question 26	Weighted
Question 27	Weighted
Question 28	Weighted
Question 29	Unweighted

APPENDIX C

Correlations Among Teacher and Student "Use" Variables

		Integrating technolgy-based software into the teaching and learning process	Expect students to turn in assigments produced with technology	Provide inquiry-based learning projects	Meet individual student needs with help of technology	Co-operative group learning processes	Project-based learning	Students use computers only in a lab.	Students use technology in at least some of their regular clasrooms.	Students actively participate in distance learning with other schools.	The primary student-related use of technology is to teach students how to use the technology itself.	Students use technology to improve their basic skills with drill and practice programs.	Students are developing online research expertise.	Students are interacting/communicating differently and more widely with the help of technology in the classroom.	Students became more independent learners as a result of technology.	Students do more schoolwork when not in school.
Teacher use in classroom:																
Integrating technology-based software into the teaching and learning process	3.000	1.000														
Expect students to turn in assignments produced with technology	6.000	0.376	1.000													
Provide inquiry-based learning projects	2.000	.490	0.534	1.000												
Meet individual student needs with help of technology	1.000	0.492	0.381	0.566	1.000											
Co-operative group learning processes	5.000	0.353	0.275	0.440	0.487	1.000										
Project-based learning	4.000	0.381	0.367	0.516	0.447	0.622	1.000									
Student uses:																
Students use computers only in a lab.	8.000	-0.055	-0.001	-0.021	-0.048	-0.067	-0.031	1.000								
Students use technology in at least some of their regular classrooms.	4.000	0.329	0.275	0.305	0.305	0.266	0.245	-0.288	1.000							
Students actively participate in distance learning with other schools.	9.000	0.161	0.172	0.198	0.172	0.171	0.178	-0.046	0.198	1.000						
The primary student-related use of technology is to teach students how to use the technology itself.	7.000	-0.075	-0.053	-0.047	-0.017	-0.027	-0.051	0.210	-0.088	0.015	1.000					
Students use technology to improve their basic skills with drill and practice programs.	6.000	0.152	0.002	0.056	0.153	0.105	0.024	0.103	0.091	0.018	0.178	1.000				
Students are developing online research expertise.	3.000	0.348	0.401	0.445	0.323	0.258	0.321	-0.032	0.290	0.246	-0.058	0.033	1.000			
Students are interacting/communicating differently and more widely with the help of technology in the classroom.	2.000	0.438	0.382	0.457	0.405	0.312	0.348	-0.085	0.386	0.203	-0.058	0.099	0.580	1.000		
Students become more independent learners as a result of technology.	1.000	0.438	0.303	0.417	0.383	0.274	0.327	-0.058	0.288	0.152	-0.036	0.090	0.382	0.571	1.000	
Students do more schoolwork when not in school.	5.000	0.120	0.171	0.235	0.233	0.184	0.176	-0.025	0.073	0.092	0.002	0.003	0.142	0.191	0.258	1.000

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