Technology in American Schools: Seven Dimensions for Gauging Progress

— A Policymaker's Guide —

Milken Exchange on Education Technology

MILKEN EXCHANGE ON EDUCATION TECHNOLOGY

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Preface

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?

Over the last year the Milken Exchange on Education Technology has emerged as the nerve center for educators, business representatives, researchers and policy leaders to address this question. 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.

Educators must chart their course toward the effective use of technology in learning and show evidence of progress along that path. The framework in this document does just 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 (see sidebar).

The Milken Exchange anticipates that the educational community, technology coordinators, policymakers and researchers will use this framework as:

- a vision that will define expectations for the public investments in K-12 learning technology;
- a self-assessment tool that assists schools, districts and states to gauge their own progress toward that vision;
- a planning tool for strategizing how to bring technology and telecommunications into their systems in ways which improve student learning;
- an accountability system for tracking the return on public investments in education technology; and,
- a research agenda that will help guide studies of how and under what conditions technology is an effective tool for learning.

The Milken Exchange sincerely hopes that this document will stimulate discussion, debate and action as educators tackle these difficult challenges. The education communities that use this framework are invited to share both the context of their use of the framework and suggestions for improvements. A number of respected experts in the field of education and learning technology have contributed to ideas expressed in this document. (See Acknowledgments.) The Milken Exchange extends its sincere thanks.

Cheryl Lemke
Executive Director,
Milken Exchange on Education Technology

The framework is comprised of 7 interdependent dimensions:

1. Learners
2. Learning Environments
3. Professional Competency
4. System Capacity
5. Community Connections
6. Technology Capacity
7. Accountability

“The public is looking for a return on its investment, and it rightly should.”

Lowell Milken,
President and Co-Founder of the Milken Family Foundation,
commenting on the $5 billion annual public expenditure on K-12 education technology.

"Today's kids bring a new culture to the family landscape. Children understand computers because they can control them. They love them because they can make their own windows of interest. Remember sitting in class? If what the teacher said was too simple, you lost interest. If it was too hard, you lost interest. And oh how tiny that window was."

Nicholas Negroponte, in the foreword to
Seymour Papert's *The Connected Family*, 1998

Introduction

Technology is a part of children's everyday lives. They don't know a time without space travel, pagers, cell phones and the Internet. While most educators concur that technology is important to student learning, many are finding that integrating technology into the education systems and using it in ways that increase student learning and achievement are far more complex tasks than expected.

The digital age is literally knocking at the schoolhouse door. Despite the fact that recent public opinion polls indicate communities are strongly supportive of technology in schools, there remains a lack of sophistication of use among the majority of schools across the United States. The unique combination of what is known today about brain research and cognitive learning theory, combined with the high-speed, networked computers that are slowly making their way into schools, presents educators with opportunities never before possible. The question is whether or not educators and the education system will act strategically enough to capitalize on this unique opportunity.

An annual report, *Technology Counts*, commissioned through *Education Week* by the Milken Exchange, provides a state-by-state report on progress being made with education technology (www.edweek.org). It states, "Parents and Corporate America are clamoring for schools to move more quickly to embrace a high-tech vision for education. And the fast-changing landscape of education technology only complicates the task for policymakers and administrators who seek to make 'smart' decisions about how to proceed."

Yet, proceeding they are. This year alone the public will invest over $5 million in K-12 learning technology. Up to $1.43 billion per year in discounts is targeted for schools across the country beginning in 1998 through the Education Rate (E-Rate). The Telecommunications Act of 1996 called for these discounts. Pending the ongoing possibility of congressional action, the E-Rate discounts are expected to increase considerably the number of school connections to the Internet. The current administration, together with Congress, has dedicated more than $1 billion for technology and telecommunications over the next five years for K-12 schools. While the total figure represents less than 2% of the national education budget, it is still significant enough to draw national interest and attention to the issue of learning in the schools.

Business and industry began investing in information technology over twenty-five years ago. Billions of dollars were spent on the installation of information technology with little or no change in productivity. Due in part to the fact that many simply used it for increased automation, it wasn't until fairly recently — the last quarter of 1997 — that a positive growth of 5% was finally noted in productivity.

The CEO Forum, an affiliation of businesses supporting technology in the schools, reported in October '97 that Corporate America has not been able to easily quantify any gains in productivity due to technology. That CEO report goes on to say that "maximizing the benefits of information technology is a multi-stage process that occurs over a period of years." Just as business and industry needed time to devise a way to best use their technology, so too will the schools; the public should anticipate that the education system will require time for this natural evolution of transformation and change."

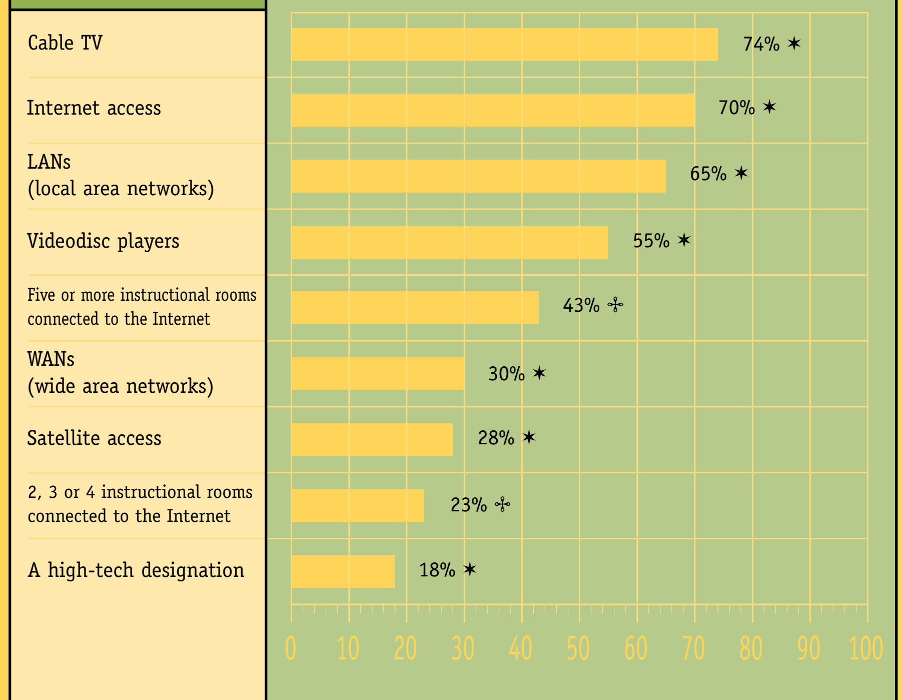
STATISTICS FROM 1997 TECHNOLOGY COUNTS

STUDENTS PER:

Multimedia computer 21:1

CD-ROM: 21:1

PERCENTAGE OF SCHOOLS WITH:

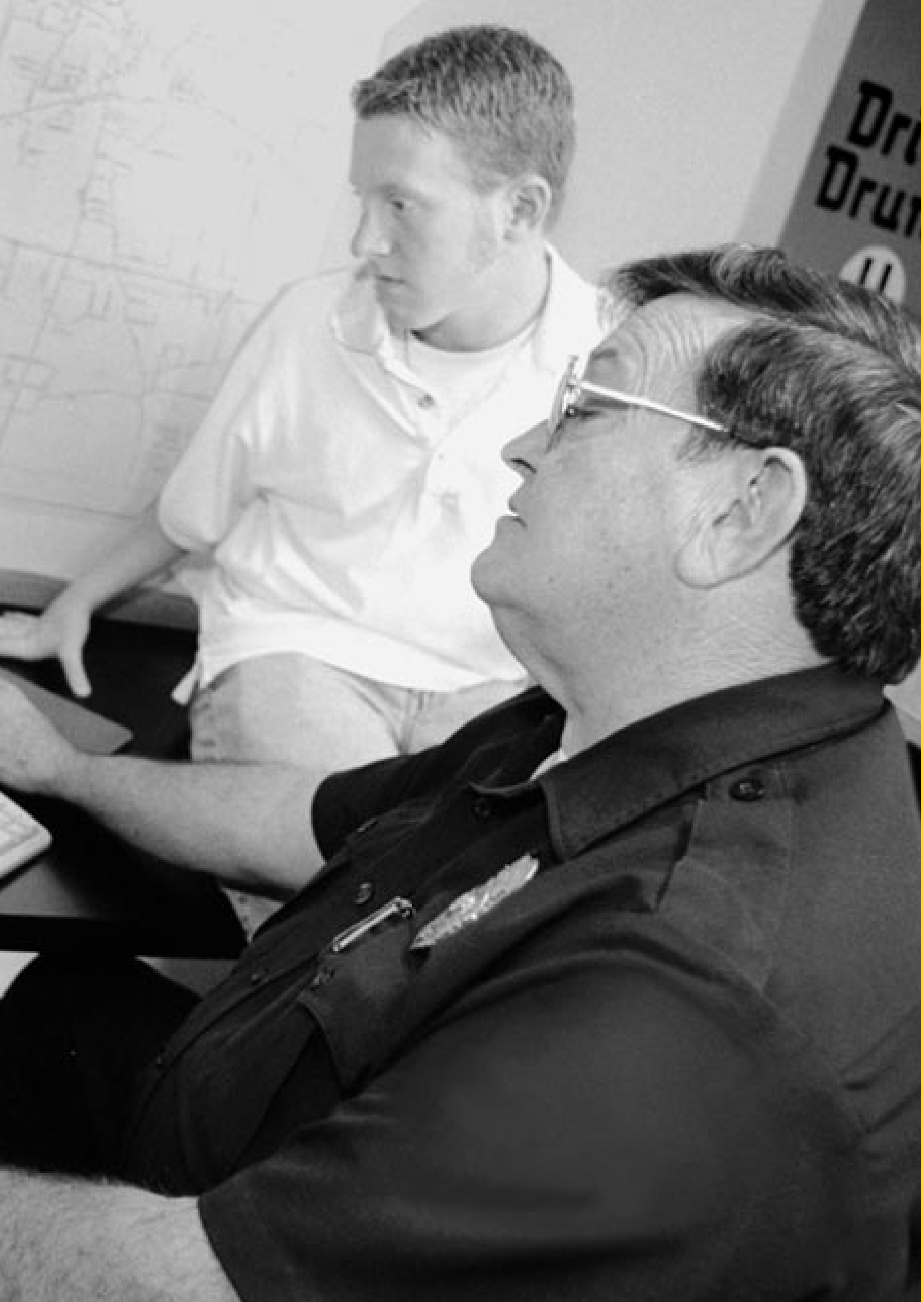


✶ Source: *Market Data Retrieval as quoted in 1997 Technology Counts*

⚘ Source: *National Center for Educational Statistics 1997*

"The first time that we went out and met with the firemen, I think that there was some unease there about our age and about, you know, us being from a high school and taking on such a task. But, as they have seen with our finished product, their view has totally changed, and they see us more as an asset."

High school student from Greenbrier, Arkansas, who, together with another student, worked under the direction of a high school teacher to design a Geographic Information System (GIS) database to warn firemen when hazardous materials are present at the site of a fire.



Students in the Greenbrier, Arkansas, high school are taking on new roles in their community using their technological expertise to help their local fire department save lives. The Information Era Learning Center was started by Tim Stephenson, a history teacher at the school, with support from high-tech partners.

In Stephenson's project-based classroom, students using Global Information Systems (GIS) software and Global Positioning System (GPS) hardware found a way they could use their classroom experience to effect real life. The town's fire chief came to Stephenson asking for help with a specific paperwork problem within the fire department. At the time, the fire department was using hand-drawn diagrams of floor plans to the town's buildings identifying problematic areas, exits and places where hazardous materials were stored. During a fire call, the maps blew out an open window, leaving the department without the necessary backup information. As a result, the department came to Stephenson, asking if his class could provide help in bringing up-to-date computerized information to the town's fire department.

Stephenson's class worked with the University of Arkansas at Fayetteville to obtain data files on the roads in the town, while

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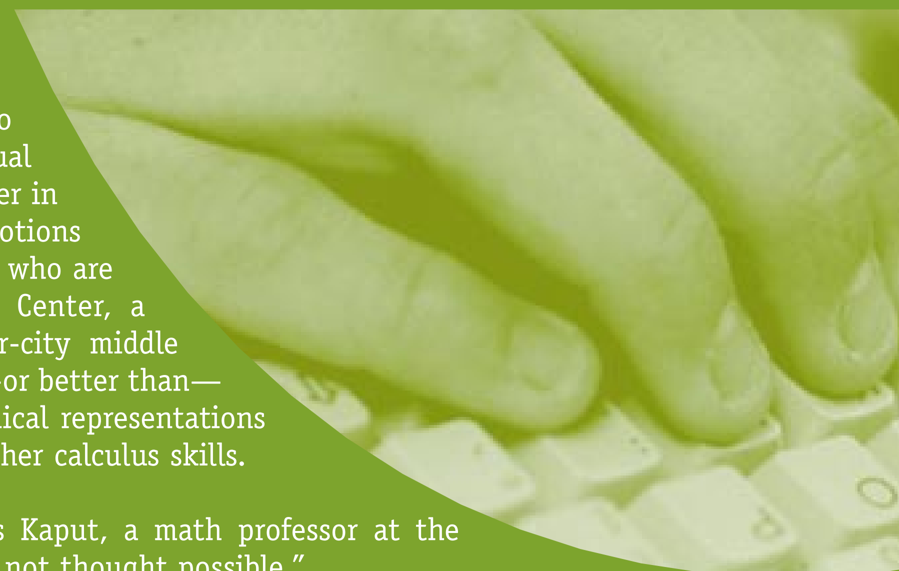
As educators work to transform schools into places that effectively prepare students to live, learn and work in a global, knowledge-based environment, they will need to take action on three fronts:

- defining what it means to be educated in the context of a digital, knowledge-based society;
- transforming schools into high-performance learning organizations responsive to this new definition; and,
- establishing new measures for assessing progress toward success in today's world.

Technology brings middle school students learning opportunities never before possible.



SimCalc, a mathematical modeling program, uses advanced computer technology to introduce elementary and middle school students to basic calculus concepts. With some of the SimCalc programs, students can create mathematical functions to control the movements of animated characters on their computer screens. Individual students in a classroom, for example, can each be in charge of a different character in a marching band. Students can also use motion sensors to pick up their own motions and import that data into the computer. University of Massachusetts researchers, who are working on SimCalc in conjunction with the Technical Education Resource Center, a Cambridge, Massachusetts research firm, have tested their programs in inner-city middle schools. SimCalc students, the researchers found, were able to perform as well as—or better than—typical high school or college-age calculus students on problems involving graphical representations of motion or that require the interpretation of velocity-vs.-time graphs among other calculus skills.

"People often think of technology as doing old things better," says Dr. James Kaput, a math professor at the University of Massachusetts, Dartmouth. "But we are doing something previously not thought possible."

As reported in *Technology Counts, Education Week.*

FRAMEWORK OF PROGRESS INDICATORS

Over the course of the last year, a number of respected experts in the field of education and learning technology have contributed to the Milken Exchange's exploration of ways to assess the interim progress of education with learning technology.

This framework defines progress indicators that are intended to serve as:

- a vision for stakeholders (educational community, parents and the general public) that will help them define their expectations for their investments in K-12 learning technology;
- a self-assessment tool that assists schools, districts and states to gauge their own progress toward that vision;
- a planning tool for strategizing how to bring technology and telecommunications into their systems in ways which improve student learning;
- an accountability system for decision makers to track the return on public investments in education technology; and,
- a research agenda that will help guide studies of how and under what conditions technology is an effective tool for learning.

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the county highway department provided them with aerial maps of the town showing the positions of the buildings. The students then matched the street files to the aerial photographs, creating a detailed GIS database record for each building. When finished, it provided the fire department with the ability to pull up a specific record for any building in the town, locate water sources, exits and any hazardous materials present in each. Not only did this provide user-friendly information to the firemen, but it also completely updated all the previous town records. As a result of the new software, the fire department is presently upgrading outdated computer hardware to student-designed system specifications, which will allow them to run the new software to its maximum capability.

When the police department saw a presentation for the City Council that the students made about their new system, they requested a forms management program to reduce the amount of time officers needed to spend on unwieldy paperwork. "The officers on the police force now look at us very differently," says Max, a senior who works as a part-time consultant for the police department. "We're a welcome sight when we drop by the station. They always have a list of questions ready to ask."

Tim Stephenson,
Greenbrier High School, Greenbrier, AR

Why Technology in Schools

If technology is to be used successfully in schools,
we must acknowledge and address some significant challenges:

- setting high standards reflective of today's technological age,
- driving a national research agenda to inform practice,
- building the capacity of local schools and districts to implement the conditions for such learning environments, and,
- documenting and reporting results.

A national research agenda will be required to more fully explore the "essential conditions" under which technology and telecommunications must be introduced to truly make a positive difference in student learning. The results of small-scale studies from research projects and grant programs such as the National Science Foundation and the Department of Education's Challenge Grants indicate that technology and telecommunications, when used in combination with appropriate learning theory, system support and sufficient access, can positively impact learning.

WHILE FURTHER RESEARCH STUDIES ARE NEEDED, EMERGING TRENDS INDICATE THAT UNDER THE RIGHT CONDITIONS TECHNOLOGY:

ACCELERATES, ENRICHES AND DEEPENS BASIC SKILLS:
Technology has been shown to enhance reading, writing, mathematics and the sciences. Far from replacing these basics, technology has the potential to enhance the ability of students to develop these essential skills and apply them in today's digital age. Students must be able to work collaboratively in applying problem-solving and critical thinking skills together with basic skill competencies through online communication, analyzing and processing of data, and designing and producing products.

MOTIVATES AND ENGAGES STUDENTS IN LEARNING:

New technology can engage students in real-life applications of academics and encourage students to be more independent and responsible for their own learning. With the rapid rate of change inherent in our knowledge-based society it is important that students have the self-confidence, knowledge base and technological fluency that enables them to continue to learn throughout their lives. Interesting applications of technology facilitate the study of the academics within the context of meaningful, authentic applications.

HELPS RELATE ACADEMICS TO THE PRACTICES OF TODAY'S WORK FORCE:

Learners in the 1990s face significantly different and more complex challenges and opportunities than previous generations. Whether it's laser surgery in the medical world, 24-hour global banking in the financial world, or digital imaging and real-time global satellite feeds in the media, the influence of technology in almost every field of professional endeavor is increasingly pervasive. If American education is to remain relevant, it must account for these changes in its curriculum.

INCREASES ECONOMIC VIABILITY OF TOMORROW'S WORKERS:

Technology is key to a strong and vibrant 21st century American economy. Workers fluent in both how to think with and use technology will make the workplace more effective, increasing productivity and helping ensure America's competitiveness in a global economy. The time to begin preparing our children for the realities of the new American workplace is now.

STRENGTHENS TEACHING:

Technology adds a powerful tool to teachers' repertoires, enabling them to meet the individual learning needs of their students more effectively. Network technology also serves to break down the isolation of the teaching profession, allowing teachers to connect with each other across vast distances and exchange ideas, share resources and improve practice.

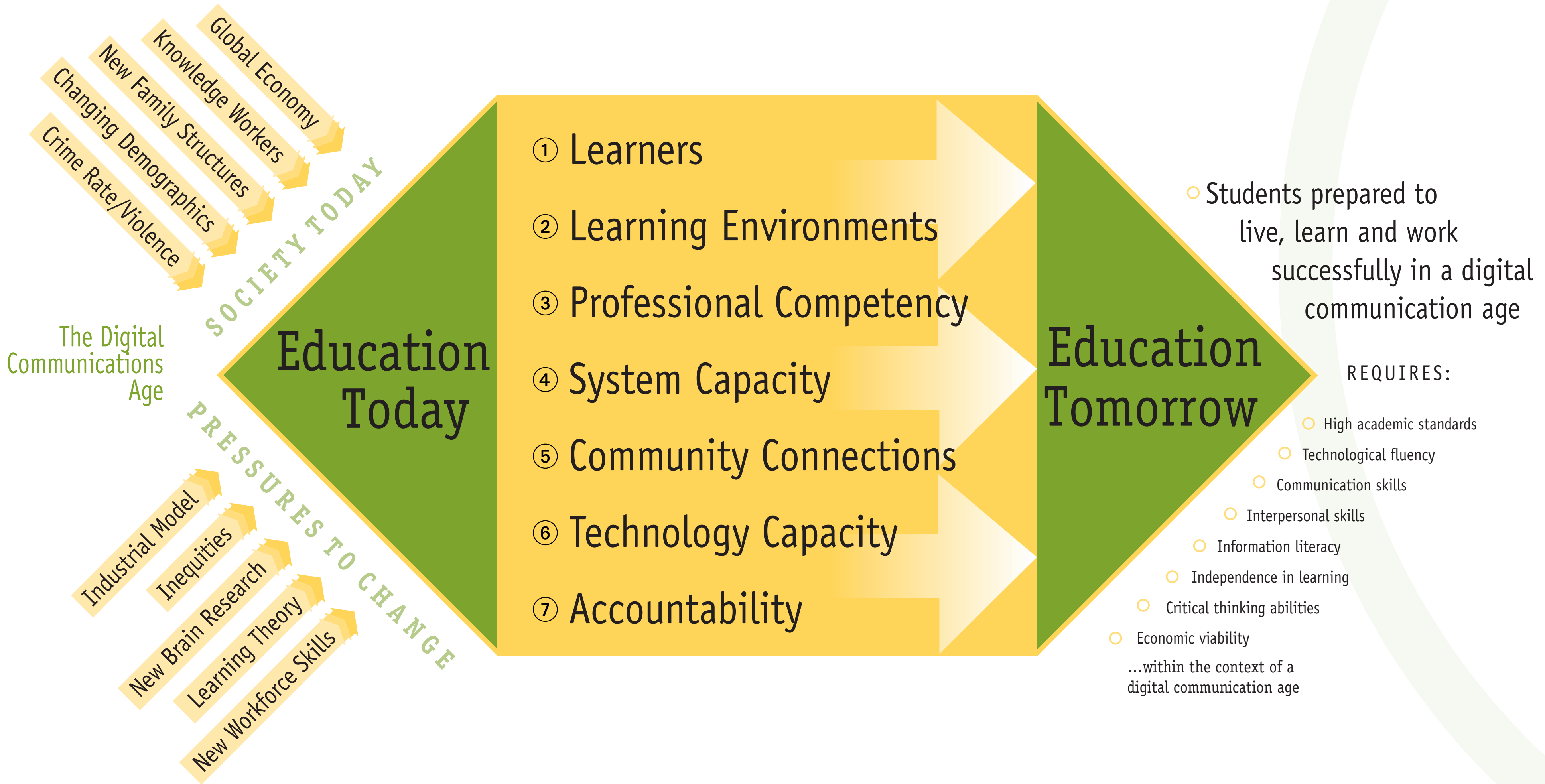
CONTRIBUTES TO CHANGE IN SCHOOLS:

The decline in public confidence in America's public schools is due in part to the incompatibility of an industrial age model attempting to meet the educational requirements of today's information-based society. Technology can be an effective catalyst for education reform, as it requires educators to rethink current practices and inspires them to make fundamental improvements in the system.

CONNECTS SCHOOLS TO THE WORLD:

Connecting learning to the world beyond the classroom can bring relevant, real-life context to the study of basic skills, work skills and critical thinking. This creates an opportunity for students to access information resources, communicate with experts and peers and make contributions to knowledge bases through electronic publications. In addition, it creates an important link between the home and the school.

Education Technology 7 Dimensions of Progress



The Seven Dimensions

The education system of today has a number of significant pressure points needing change. Outside pressures such as global economics, new family structures, changing demographics and new work force requirements are creating the public will to change. But the schools themselves must find the road to such change—one that is not clearly marked or well traveled.

This framework of progress indicators is an attempt to chart that course, identifying the essential conditions that must be working together if schools are to bring technology-enriched learning opportunities to students, systematically and equitably.

A continuum of progress has been constructed for each dimension and is available in a companion document. These continuums include three levels: *Entry*, *Adaptation* and *Transformation*. For each of the topics and key questions within a dimension, a profile is provided so that the reader might begin to grasp the idea with some clarity. Transition steps have also been included to assist the reader in strategizing how to move from one stage to the next.

While this model represents a synthesis of the thinking of a number of respected professionals, it has yet to be researched and tested. The intent of this publication is to help policymakers answer the question, "What is the return on the public's investment in learning technology for K-12 schools?"

The Milken Exchange invites education communities who use this framework to share with the authors both the context of their use of this framework and their analysis of its usefulness. E-mail Cheryl Lemke: clemke@mff.org, fax: 310/998-2899 or voice: 310/998-2825.

The framework is comprised of 7 interdependent dimensions:

1. Learners
2. Learning Environments
3. Professional Competency
4. System Capacity
5. Community Connections
6. Technology Capacity
7. Accountability

Each dimension includes a list of the various questions the public, policymakers, educators, community members and business and industry representatives should ask—and educators should answer—as technology and telecommunications are deployed in K-12 schools.

1 LEARNERS

In looking at the LEARNERS dimension, 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, advance their knowledge of the world around them?

Learners in the 1990s face significantly different and more complex challenges and opportunities than previous generations. The world outside the classroom has changed significantly due to technology. Whether it's the laser surgery in the medical world, the 24-hour global banking in the financial world, or the digital imaging and real-time global views from the media, life is different as a result of technology and telecommunications. If the academic institutions are to have relevance they must reflect the most significant of these changes.

The International Society for Technology in Education (ISTE) recently released the National Education Technology Standards (NETS) for students. ISTE and their partner organizations recommend that these standards "be used throughout the curriculum for teaching, learning and instructional management." More than 38 states currently have technology standards for students. In the majority of those states the technology standards are being integrated into the academic standards, but few states are currently assessing student progress on these technology standards.

Educators teach what is assessed. It will be important that the education community establish measurements that accurately, reliably and cost-effectively assess students' technological fluency in the context of learning academics. The next steps will be in developing assessment measures for these stages. The scenario on the facing page provides a look at a student who has achieved technological fluency and fits this profile of a student ready for a digital age.

PROFILE: LEARNERS

FLUENCY:
The student is proficient using technology and communication networks for whatever endeavors he/she chooses.

STRENGTHENING THE BASICS:
The use of technology makes it possible for the student to learn the basics with more depth and understanding.

DEVELOPING HIGHER LEVEL SKILLS:
This use of technology makes it increasingly possible for the student to engage in learning practices that lead to new ways of thinking, understanding, constructing knowledge and communicating results.

INCREASING RELEVANCY:
The student is using contemporary technology, communication networks and associated learning contexts to engage in relevant, real-life applications of academic concepts. His/her work parallels the way in which professionals in the work force use technology.

MOTIVATION TO LEARN:
The quality access to technology and telecommunications is increasing the intrinsic motivation of the student to learn.

RECOGNITION OF TRADEOFFS:
The student is cognizant of the tradeoffs inherent in the application of technology in society as he/she makes life choices in a global, technological society.

In a small town in northern New Mexico, technology is changing the way students are learning: In Lorenzo Gonzales' science classes in Cuba, New Mexico, 100% of his students live below the poverty line. Due to its isolated location, Cuba High School, which serves low-income students from the Navaho reservation, has also suffered from a lack of relevant educational tools. In 1984, when computers first arrived in classrooms nationwide, the school library had only two books related to science: a 1949 publication on biology and a 1952 publication on botany.

With these conditions prevalent, Lorenzo says the arrival of technology was long overdue. "Technology, and in particular the Internet, is an equalizer for my kids. It is not only the [current] information that makes the difference to my kids; it's the variety of people to whom they have access."

Last year, one of the students in Lorenzo's class teamed up with a retired aerospace engineer who was involved in a photometric study of binary stars. The student was able to remotely control the telescope, thereby capturing pictures of the stars through the use of the Internet. This year, two other students, utilizing the Internet for research papers, finished 1st and 3rd in the Southwest Science and Humanities Symposium, held every year for high school students throughout the southwestern states. The winning paper, a study of the use of fermentation to break down cellulose in cow manure for improved composting, would not have been possible without the Internet, says Lorenzo. "We've come a long way from just ten years ago, when this school was suffering from a severe lack of resources. In remote and economically disadvantaged areas of the country, the Internet is a pathway to greater knowledge and resources that could not otherwise be provided."

This year, the winning student collaborated with a biochemical engineer from New Mexico State University. His work involved exhaustive research on the Internet, often relying on the same information resources that the biochemist used for his own professional research.

Other examples of the Internet's influence on students include the work of basic level geology students at Cuba High who are expanding their study of fossils by collecting specimens from the fossil-rich desert surrounding Cuba, then researching their specimens through the Internet and publishing their results on a Web page. As Lorenzo describes it, "Technology in my science classroom is not just a tool; it is a partner. It has allowed my students to do real science, not just science projects."

2 LEARNING ENVIRONMENTS

In looking at the LEARNING ENVIRONMENTS dimension, we are asking...

Is the learning environment designed to achieve high academic performance by students through the alignment of standards, research-proven learning practices and contemporary technology?

For the education community, the digital age is not about technology. It's about what learners are doing with the technology to extend their intellectual capabilities and better understand the world around them. The challenge before American schools is in putting into place the conditions that are essential to make these tools truly effective in improving student performance.

Introducing computers into language arts won't have much of an effect if all students do is word processing of compositions. The real value comes in engaging students in a writing process through which the technology enables students to more coherently plan their composition through outlines, get feedback from peers and experts across networks, introduce visual imagery, icons and animation to more effectively communicate ideas, access a wider range of source material for background information, use databases to better organize such materials and then, publish to the world. The positive learning effects of these powerful tools are dependent on the context of the learning environment.

The scenario on the facing page provides readers with a glimpse into a learning environment that has been designed to put students in more independent and active roles in learning. Through the intelligent and thoughtful use of technology, students in Julie Leake's Kentucky classroom are engaged in learning through active questioning, discussions and sharing of knowledge across networks. The continuum included in the companion document for educators provides the range of steps educators are moving through to create the learning environments that combine the best of traditional teaching with cognitive learning theory and technology to optimize learning for children in K-12 settings.

PROFILE: LEARNING ENVIRONMENTS

LEARNING CONTEXT:

Educators are establishing a learning context that requires and enables students to use contemporary tools to research issues, solve problems and communicate results, both individually and in teams.

LEARNING CONTENT:

The standards, curriculum, instruction and assessment reflect the knowledge-based, global society of today. Educators are reflecting societal changes in school practice.

SCHOOL CULTURE:

The school culture is one that encourages, enables and rewards educators individually and collectively to improve the learning and teaching processes through the effective use of technology and communication networks.

TECHNOLOGY ACCESS:

Teachers and students have sufficient access to productivity tools, online services, media-based instructional materials, and primary sources of data in settings that enrich and extend their learning goals.

INFORMATION AND COMMUNICATION:

The learning environment is a place where the effective use of information and communication technology is modeled for and by students.

The creation of environments in which students effectively use technology in their learning processes is about change, pedagogy and innovation. Julie Leake, a primary school teacher at Byck Elementary School in Louisville, Kentucky has created an environment for her students to develop as life-long learners using "CSILE" (Computer Supported Intentional Learning Environment), a software program developed in 1994 at the University of Toronto. Authors Marlene Scardamalia & Carl Bereiter originally developed the program for university and graduate level students to help them think about how they process thoughts about research literature and class projects. Consisting of a collective networked database of students' thoughts, it makes information generated by individuals, instantly accessible to other members of the group.

Julie Leake heard about CSILE's usage in the process of investigating learning technology tools for her students and decided to see if the program could be customized for usage with much younger students. In the process, she discovered that, not only were her students able to grasp concepts thought only suitable for more developed minds, but that in the process of developing higher cognitive functions, they were able to take a much greater role in their own learning.

Explaining the reason she decided to try CSILE, Leake says, "I have a philosophy of teaching that involves trying to develop 'purpose' in the learner. I believe that it's important for children, for learners in general, to understand what it is they're trying to find out and why they need to know it. With CSILE, a knowledge-building program, children explore a variety of ways of thinking."

Demonstrating this point, she describes a software program her class uses as part of CSILE called "Knowledge Forum," in which different views are presented pertaining to specific subjects being discussed in the classroom. "The children can use Knowledge Forum to find a view appropriate to the topic we're discussing. They can then give their own theories, which I record or which they type directly into the database. That information is then available for all the children in the learning community to see; it can also be viewed by other classrooms on the team or by others in the school who might be exploring that same topic at a later time."

By using this technology, Leake has been able to save the school money previously spent on paper, copies, and display charts. Instead, she now uses an overhead LCD panel to project on-screen information to her students, which can be updated as they learn. Students can also access records later for research purposes from individual computer stations available in the classroom.

But what she finds particularly rewarding about the use of CSILE is the ability it provides to develop a cooperative learning environment where students can learn from each other, creating a format for future learning and working relationships, as opposed to the competitive win or lose systems of the past.

3 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?

Educators are the key to the effective use of technology in schools. It is only through change in classroom and school practice that the positive benefits of technology to learning will be realized. While many educators are embracing the use of education technology, many also have a healthy skepticism about the benefits and tradeoffs of technology in schools. Teachers need visions of how technology can enhance and enrich learning opportunities for students in ways that were never before possible on a large scale — and they need time to explore these new approaches.

Technology should be presented, not as a silver bullet, but as a powerful catalyst and tool for overall school improvement. It is important that educators see the connections across all facets of their profession — cognitive learning theory, academic standards, assessment methods, accountability systems, contemporary technology and their own learning. The continuous professional growth of educators needs to be both intrinsically and extrinsically rewarding.

The U.S. Department of Education projects that the K-12 education system will need as many as two million new educators by the year 2010, due to anticipated retirements. This represents a unique opportunity for the K-12 education community to ensure technological fluency in future teachers through their initial preparation rather than after they join the profession. Collaborations between institutions of higher education and K-12 schools will contribute greatly to this effort. The scenario on the facing page and the continuum companion document for educators provide readers with a look at the learning curve ahead for educators as they seek to improve K-12 education through technology.

PROFILE: PROFESSIONAL COMPETENCY

CORE TECHNOLOGY FLUENCY:

The faculty and staff are proficient, knowledgeable and current with contemporary technology.

CURRICULUM, LEARNING AND ASSESSMENT:

The teacher's fluency with technology has translated into unique learning opportunities for students. The teacher's knowledge about technology's impact in his/her field of study is reflected in the context of his/her students' learning.

PROFESSIONAL PRACTICE AND COLLEGIALITY:

Teachers are using technology and communication networks to advance their professional practice. Teachers are knowledgeable and current with the technology and its impact in their field of study and the larger society.

CLASSROOM AND INSTRUCTIONAL MANAGEMENT:

Through their use of technology and telecommunications, teachers are creating learning contexts that require students to take on more independent roles in their own learning.

Jo Williamson defines professional development in "engaged learning" as getting teachers familiar with what is best in practice and what research says about classroom instruction and learning. "The engaged learning model has 26 indicators that tell you what classrooms ought to look like: They need to be collaborative, kids should be working on real tasks, teachers and students should have these kinds of roles. It's a broad overview of best practice in teaching and research, as well."

During the first phase of the project, teachers worked in collaborative teams to design an engaged learning project that was real and useful. To do so, they were provided with a bibliography of online professional development resources and fluency in the use of the technology. The project coordinators then stepped aside and let the teachers explore and learn ways to work together to reach this goal. In the process, they got to experience first-hand what engaged learning is all about from a participant's perspective.

"We provided teamwork and resources," says Williamson, "and they had to grapple with the issues that came up as they constructed something. It changed the way they taught because it was modeled for them. All the training was centered around that. We even balked at the word 'training' because it wasn't like we were imparting knowledge to them. The very first day, they were presented with exploring new models of teaching and actually writing a unit that exemplified what we knew was best. So they were immersed in creating those units and that's where the change came from."

During this process, teachers communicated with each other using e-mail as well as meeting together five days each semester. When they reached a point where they had a vision for a technology-supported engaged learning unit, the teachers then implemented these units in their classrooms. Williamson notes one such project: an interdisciplinary math and science learning experience where kids learned mapping and data collection skills at a local forest preserve. "They went to a forest preserve to map streams and used technology to actually make these maps of streams that had not previously been mapped. Then they learned how the maps changed." The students also counted fish as part of the learning experience on data collection and ecosystems, gaining a wider perspective than they could have learned with books alone. To share their vision with others, teachers used multimedia technology to document their projects. Those records were archived and later made available through the district's Web site.

To measure the effectiveness of this project, the teachers were asked to provide baseline data on their teaching practices before, during, and after their exposure to the program, using the project indicators as guidelines. Each year, they repeated the inventory to demonstrate how their teaching practices had changed. Williamson recalls that the biggest change was to the roles teachers and students played with a measurable increase in collaboration. "[This experience] changed the way they taught. It was probably one of the best learning experiences that they had. We just haven't experienced that kind of change before."

4 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?

Technology—properly managed and applied—has the potential to restore rigor to children's learning, to rebuild public confidence in

American education. As discussed in initial sections of this publication, technological fluency of students and teachers, together with enabling learning environments, are essential to making this happen. But those alone are not sufficient. It also requires systems thinking.

The solution lies in the reengineering and alignment of every level of the system, from legislative policy to classroom practice. If the transformational stages for learners described in section 1 of this document are to be reached, educational leaders have a responsibility to realign the entire education system in support of those goals. That translates into the development of human capital; access to exemplary prototypes; adequate planning time; adequate resources; alignment of curriculum, instruction and assessment; requirements for teacher and administrator credentials for learning technology; inclusion of technical support personnel and capital/non-capital infrastructure items in allowable expenditure categories; and provision of ongoing technical assistance.

The scenario on the facing page and the continuum in the companion document for educators represent the stages most education systems will progress through as they transition from the traditional to the reengineered. To do so will take more than projects and initiatives. It will take changes in the very culture and structure of the education system. Business and industry have found it necessary to reengineer their practices to take full advantage of technology and telecommunications. Education must do the same.

PROFILE: SYSTEM CAPACITY

VISION:
The system has engaged key stakeholders plus the broader community in defining and clearly stating a compelling vision and clear expectations for technology in schools. The entire system is committed to that vision.

LEADERSHIP AND PLANNING:
The system has developed a comprehensive, long-term plan. Alignment exists between the plan for technology in schools and existent policies and practices (e.g., rules and regulations, fiscal priorities, operating practices, allocation of resources, investment in human capital and accountability).

ENSURING CAPACITY:
The system has ensured that educators, communities and components of the system itself have the capacity to translate that vision into compelling, meaningful learning activities for children, youth and adults.

SYSTEMS THINKING:
The vision for improved learning through technology is a design factor across the entire education system.

Technology in schools is on the radar screen of nearly every governor, state legislator and state superintendent in the nation. Each state is charting a different course for bringing technology into the public schools. Highlighted below are some key capacity-building initiatives in various states. The reader should be aware that these highlights are not meant to be a comprehensive look at any one state's approach.

Kentucky: Strong Leadership

Noted for its national leadership in education reform, Kentucky's approach to technology has paralleled the Kentucky Education Reform Act's demand for equal opportunity for all Kentucky students. As a beginning it provided the leadership and vision to see technology, not as a silver bullet, but as a critical component of education reform as the state and nation enter the 21st century. The price tag for the technology component of the education reform was estimated to be $533 million over 6 years. With strong support from three governors and a legislative appropriation of over $150 million this spring, Kentucky became the first state in the nation to fully fund a comprehensive technology plan.

North Carolina: Certification Requirements for Teachers in Technology

North Carolina's State Education Agency and its Higher Education Governing Board have passed regulations requiring all new teachers to possess specified technology competencies for initial certification. Beginning in 1998 this certification will be performance-based. Each teacher in North Carolina must successfully complete a 3-5 year cycle on technology competencies relevant to their licensure area for license renewal.

Ohio: Access for Students

In 1994 the Ohio State Legislature and Governor Voinovich established an ambitious program to add technology resources, professional development, and connectivity to every public school in the state. Ohio SchoolNet provides wiring standards and is wiring every public school classroom in the state for data, voice, and video connectivity. SchoolNet Plus has provided $430 million to acquire computers and training for K-4 classrooms with a program target of one computer for every five primary-grade students. Standards for hardware, connectivity, and components ensure district interoperability and access to state and regional resources. Every district in the state has developed a district technology plan as a prerequisite for participation in state technology initiatives. Twenty-six data acquisition sites and eight regional educational technology agencies provide regional technical support and professional development.

New Jersey: Buy-In by Stakeholders

Four critical action areas were identified by a New Jersey task force in 1993 for education technology: building education leadership, preparing educators for new roles, modernizing learning environments, and developing networks and technology infrastructure. Through their ambitious state plan, every district was required to develop a technology plan, technology was incorporated into the content standards for K-12 and state funding has been provided for 21 county-based Education Technology Training Centers to support districts in implementing those plans, particularly in terms of professional development. Last year the state's Comprehensive Educational Improvement and Financing Act provided $250 million in state funds for infrastructure over a five year period. Facilities standards for technology have been developed to guide that process.

In this new area of learning technology, many states are finding that it is not enough to simply set high standards and provide initial funding. Most districts need support, guidance and leadership along the way.

5 COMMUNITY CONNECTIONS

In looking at the COMMUNITY CONNECTIONS 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?

The concept of "school as community center" has been making its way back into cities across the country with a new twist; both local and global communities can now get involved. Community investments in technology for schools not only benefit K-12 students, but also pay dividends for citizens in new opportunities. Possibilities include: increased access to computer services, electronic information on the Internet and higher education classes via satellite or interactive video, student access to expertise among local and global community members and some compelling new ways in which students can give back to both communities through their high-tech expertise.

With the scarcity of community and school resources, any leveraging and sharing of resources is tremendously beneficial. Communities are pooling resources to share expertise, services and products in this high-tech arena. On the local level, the advent of e-mail and Web sites has opened up the classroom to fuller participation by parents and community members. Parents can now communicate with teachers during non-business hours in addition to accessing homework assignments, supplementary learning materials and other online resources.

With the level of investment necessary to deploy and sustain the effective use of technology in schools, community support is critical. As schools get wired and communities get access, the economic viability of the local region improves and the digital divide between the low and high socioeconomic areas decreases.

PROFILE: COMMUNITY CONNECTIONS

COMMITMENT:

Key community stakeholders are committed and involved in planning, funding, implementing and evaluating the system's use of learning technology.

COLLABORATION:

The system has identified and acted on the full range of mutually beneficial partnerships, exchanges and collaborations.

CLARITY:

All technology partnerships, exchanges and collaborations include clear articulation of expectations, implementation plans, time lines and accountability systems.

COMMUNICATION:

There are mechanisms for ongoing communication among partners and the broader community to celebrate successes, track progress, build awareness and involve new partners and citizens in the process.

When you help people help themselves, you create a community of learners. This was the case in the small, rural, economically challenged town of Christopher, Illinois, where the majority of the town's 2,800 resident coal miners, have rallied around two, community-based technology programs. Initially, however, this was not the case.

Beginning in 1995, the Illinois State Board of Education passed an initiative that awarded grants for instructional technology to the state's poorest school districts. In order to qualify, the district had to commit to participating in a community-based planning process. The State Board provided consultant assistance, training, and other resources to assist the districts with their planning process. In Christopher, the reaction of the community was initially very positive: Agreement was reached to purchase the necessary hardware and equipment for establishing Internet connection while home pages and e-mail capabilities were installed at the high school. School facilities were then made available to members of the community to come in and access them.

However, there was a large segment of the community, which still had lingering concerns about the use of learning technology and how it would effect them. A technology advisory board, which held a community forum, discovered that parents were concerned that if they did not own computers at home, their children would not be able to keep up with the learning process. Miners, on the other hand, wanted to take part in the learning process but didn't feel competent about their ability to grasp technological concepts, and seniors feared they would be left behind altogether and that classes would not be accessible to them.

To address these needs, the technology advisory committee expanded to 27 members as volunteers came aboard to offer their help. Free evening community computer classes were set up through the Regional Office of Education, as well as peer teacher training, group training, Internet classes and senior citizen classes, held earlier in the day so they could get home before dark. As a result, the first seven classes filled up, quickly providing 400 residents with basic computer literacy and Internet courses.

In addition, the local newspaper, The Progress, ran a survey to access the community's needs for technology training, community leaders began offering their time and expertise and the Regional Office offered additional resources and incentives to help teachers with their professional competency training.

Says Kathryn Greenwood, the high school director of technology services, "We thought nobody was interested in technology [when we started]. Instead, we found those parents, coal miners and seniors had definite views on technology."

Following the success of the high school's initiative, the Christopher Elementary School created their own local initiative, committing to a three-year staff development program to train teachers. Teachers, in turn, integrated technology within their classrooms. The school also subscribes to the online service Scholastic Network. As a result, kindergarteners are among those now able to use the Internet to share their thoughts with children all over the world.

The elementary school's involvement has further enhanced the community's access to technology with basic keyboarding classes being taught on site. As a result, parents and children are now sharing the learning together in a community where a feeling of hopelessness was previously the prevailing feeling. With the community working together, Christopher's school districts have been able to bring innovation to their small town, building a center for learning for all.

6 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?

The National Center for Educational Statistics recently released data reporting that 43% of the schools in the nation have five (5) or more instructional rooms connected to the Internet. With the public investment in learning technology expected to top $5.2 billion this year, schools are beginning to see a critical mass of technology equipment and a significant number of classrooms wired.

This rapid acceleration of learning technology in schools has, in some cases, not allowed for adequate time for the careful planning needed to invest wisely and strategically. The challenge is in looking for solutions that will provide sustainability and technical support at affordable rates. At the district, regional and state levels that often translates into taking advantage of an economy of scale where possible through state backbones, group buys and joint bidding for hardware, software and online services.

To date the technology capacity of most schools has not been sufficient for educators to use as everyday tools for learning. As this situation improves, the added staff and budgetary requirements for maintenance, operation, upgrades and replacement will be tremendous.

The scenario to the right captures one district's creative approach to the need for quality technical assistance for their infrastructure. They turned to students for the solution. A continuum in a companion document for educators provides incremental stages toward planning for, deploying, operating, maintaining and upgrading a technical infrastructure to meet the learning and administrative needs of schools and districts.

PROFILE: TECHNOLOGY CAPACITY

INSTALLED BASE:
Schools have an installed base of modern technology equipment to support the learning, communication, and administrative goals of the education system.

CONNECTIVITY:
The connectivity in the school/district is adequate to support current and rapidly growing demands created by the learning, communication and administrative requirements of the education system.

TECHNICAL SUPPORT:
There is adequate technical support to provide timely, expert troubleshooting, technical assistance, ongoing maintenance, operation and upgrades.

CLIENT ORIENTATION:
The client's technical needs are being met with a high degree of customer satisfaction.

FACILITIES:
The facilities within the system are "technology-ready."

Generation WHY is taking the nation by storm, impacting over 200 schools in eleven states. This innovative program is giving technical support, network administration and professional development a new 'look' in Olympia, Washington and beyond. In Olympia, the students are the network designers, technical consultants, and network administrators as well as the facilitators of the lesson plans, assisting educators in implementing technology in the classroom.

Founded by Dr. Dennis Harper, technology director at the Olympia, Washington School District, Generation WHY has become a model for the nation by giving secondary school students a more important role in the classroom. The idea behind Generation WHY was to consciously focus on today's youth, making them partners—and often leaders—in building and maintaining networks, supporting teachers in using technology in their classes, and in collaborating with others to provide teachers with a wide scope of resources. As a result of these efforts, students as young as twelve are now leading the charge, working as partners with teachers, and districts across the country are queuing up to get their hands on this inventive concept.

In the beginning, back in 1992, Dennis first engaged his students in the original design of the wide area network for the Olympia School District as well as the local area networks for the buildings. Those student plans for networking were adopted by the district, but the resources necessary for deployment were not then earmarked. When students realized this, they became advocates for the community funding of the project. Ultimately that had a big impact on Olympia School District's success in finding the resources to build, operate and sustain this network that transverses 18 schools and the district office. Once the resources were secured, students assisted in the deployment of the network, gaining valuable work experience for later careers. Each secondary school in the district has a group of student technical assistants available throughout the day to help maintain the district's vast technology infrastructure.

Once the students, with oversight of district staff, had the network management underway, they went on to the topic of support for district teachers to use their system. The backbone of the Generation WHY model is an 18-week course which teaches students in grades 6-12 technology, networking, mentoring and organizational skills so they can assist teachers in integrating technology into lesson plans. In the process, students increase their technical, networking, research, presentation and leadership skills. They also learn how to work cooperatively with other students from fourteen, high-tech consulting districts across the country.

Teachers benefit from this project through the increased access students provide to technological resources, including e-mail capabilities, Web forums, Web searches, news groups, and software integration. Students also assist them with presentation and communication skills like In-house TV, Web page development, scanning, digital photography, PowerPoint *presentation materials, and* Claris Works. *By engaging students in the design, deployment and operation of the school district's telecommunications network, students are both recognizing and being recognized for the valuable contributions they are making to their community while they are honing their academic, communication and team skills. The spin-offs from building this capacity in students are tremendous. These students are contributing technology expertise to a number of groups—Vietnamese parents, preservice teacher candidates at the four-year institutions, elementary after-school enrichment programs, and summer programs for the YWCA.*

Dr. Harper's initial idea to put students in charge has now exceeded all initial expectations. "These students are doing real work, with real results," says Dr. Harper. "In addition to creating more meaning and purpose to their role as students, they are helping their community, and are seen as positive role models. For further information: http://kids.osd.wednet.edu.

7 ACCOUNTABILITY

In looking at the ACCOUNTABILITY dimension, we are asking…

Is there agreement on what success with technology looks like? Are there measures in place to track progress and report results?

With the significant increases in public funding for learning technology in the late 1990s, it is essential that educators be able to account for the return on investment. Accountability is defined here to mean the responsibility for accomplishing the public mandate in learning technology. It is important to note that this translates into a responsibility on the part of the education system and the educators to establish and implement a system for documenting progress and reporting results.

To date the accountability for public investments in education technology has been reported in terms of the quantity of equipment and connectivity in school districts, schools and classrooms. Most policymakers are now turning their attention to the qualitative impact and educators simply do not have appropriate measures nor hard evidence to document changes in student learning. Until measures to do so are developed, it will be important that educators carefully document their progress on interim indicators such as the seven dimensions included in this publication.

To ensure accountability, all assessment processes must be designed during the initial planning stages. In most schools, school districts and states, accountability through assessment requires answers to the following three key questions:

- Under what conditions or context did the implementation take place? [Documenting the context.]
- Did the school do what its plan said it was going to do, when it said it was going to do so? [Documenting the process.]
- What were the results of the intervention in comparison to the original intent of the policymakers? [Documenting the results.]

Throughout all stages of this assessment process, and at all levels, stakeholders must be kept informed of progress.

PROFILE: ACCOUNTABILITY

DELIVERABLES AND BENCHMARKS:

Clear goals have been set, accompanied by logical implementation and change strategies, measurable objectives and associated metrics.

DATA COLLECTION/INTERIM PROGRESS:

A well-designed data collection and analysis process that tracks progress, leads to data-driven decision making and provides evidence as to whether or not the intervention leads toward the goals.

DATA-DRIVEN DECISION MAKING:

The data analysis is appropriately informing and contributing to the continuous improvement of the implementation.

COMMUNICATION:

A communication plan is in place that keeps all stakeholders informed and provides a feedback mechanism for continuous improvement.

"For accountability to be really meaningful, educators must first determine whether they have enough clarity about what the goals are in education for the children," says David Livingston, Principal of Peakview Elementary School in Aurora, Colorado. "I think when a school or district defines themselves so narrowly that the only evidence that's acceptable is standardized test scores, then they are not looking at what the full responsibilities are of education."

He and his staff introduced technology seven years ago as part of one of the first fully-integrated interactive classrooms. The school offers students a thematic approach to learning where topics such as rainforests are studied in depth across curricular areas. Peakview Elementary supports these innovative programs an interactive network of six classroom-based computers per class linked by a sophisticated network. Multimedia stations in each classroom allow even the youngest students to experience the excitement and accomplishment of learning through technology. Likewise, the Internet plays a central role in the classes with students and teachers working together to create a "community learning center" as part of the school's Web site.

Karen Peterson, Peakview's technical coordinator notes, "Everything is directed toward integrating technology into the curriculum ...[but] we try to assess it separately." She suggests that success with technology will depend on two things: integration into the entire curriculum and measurement of the quality of that application.

What Peakview does look at, says Principal David Livingston, is something he refers to as "indirect indicators." "We have some instincts about the level of independence that children show as they're leaving us, the success they have at middle school, their success, willingness, and ability to take on independent tasks. Those things seem greater to us [here] than in a more traditionalist environment where the heavier responsibility lays with the teacher to do all the talk and all the work. We're not claiming some objective kind of measures. [Rather] we're judging [student success] based on everything from the number of kids that show up on the honor roll in middle school to the stories those school teachers tell us about the performance of our kids, either directly or on surveys on kids' success after they leave us. I call those [factors] indirect but those are the kinds of things we're looking for and listening to without taking technology out of that mix."

As a way of creating accountability with stakeholders, Livingston says they publish test results and send home information to parents in an annual report at the end of the year. These results, he says, are not just single measurements. "Every bit of standardized assessment that we do, whether it is a bell curve type of assessment or against standards established by our district or state, we're giving parents that kind of quantifiable information, annually, about their children and the group of kids that go through Peakview."

Additionally, parents are provided with opportunities to better understand learning technology through the school's technology information nights and special technology training classes. Says Livingston, "It's just a matter of exposing parents as broadly as possible to the environment in the hopes that they will ask us questions about the role technology plays in their day."

But perhaps the most symbolic measure of students' success in grades K-5 is the electronic portfolio, which each student receives at the end of their time at Peakview. Presented in a videotape format, easily accessible to families, this portfolio documents student's contributions and assesses and celebrates their progress. "Whether the learning had anything to do with technology or not," says Peterson, "technology was the way that we provide evidence of their accomplishment within our proficiencies and standards."

Next Steps

This document is a call to action for educators, researchers, and policymakers. For over 20 years, the K-12 educational system has been analyzing emerging technology for the "value added" it could bring to learning. Schools, school districts and states that have forged ahead, including those listed in this document, have learned a good deal and provide excellent models for others to follow. But the reality is that most public schools across this nation are not yet fully capitalizing on technology for learning, in part because they do not have all of the essential conditions in place.

The public education system is continuously experiencing pressure from a society significantly impacted by technology and telecommunications. It has only been in this decade that technology has become powerful enough, communications networks extensive enough, and the computers distributed widely enough to even consider using technology as an everyday tool for learning.

The reality is that this framework is not about technology. It's about what value technology can add to learning, given the right set of conditions. And therein lies the reason for some of the healthy skepticism reported as of late in the media:

- "There's been a lot of research about CAI [computer assisted instruction] and a lot of anecdotal evidence but no body of serious research to measure whether technology will achieve its own goals *(sic)*—whether it can help in an area such as intellectual development."

  Larry Cuban,
  Stanford University
  Teaching and Learning, May 1998

- "It's time to ask a simple question: Does this mania for technology make sense? The nations that regularly leave us in the dust on academic tests—like Korea—have focused on good teaching, not on technology."

  Diane Ravitch,
  Historian and Fellow at the Manhattan Institute in New York City
  Forbes, Inc., March 23, 1998

- "Unprecedented support for school technology is spurring an investment of billions of dollars. But a lack of research and a dearth of data mean the payoff is unclear."

  "Technology Counts" (November 10, 1997),
  Education Week

Public policymaking in general is often complicated, intense and controversial. The topic of learning technology is no exception. As technology comes of age in American schools critical choices will have to be made about access and content focus.

Educators finally are beginning to have sufficient (albeit not adequate) infrastructure to begin viewing technology as an everyday learning tool. Now is the time for wise, intelligent use of these resources in ways that bring American schools closer to meeting the needs of all children. To do so will require a number of actions on a number of fronts. The Milken Exchange is recommending that those actions coalesce around the comprehensive framework of the seven dimensions of progress in this publication.

The literature suggests that some districts have identified the essential conditions for capitalizing on aspects of the value technology can bring to student learning. Now is the time to carefully research those successes and bring the best of those practices to scale in ways that positively impact all students. As this is done, it will be important to focus not on the specific intervention, but rather on the combination of essential conditions that make it highly probable that the school will be able to effectively use technology to add a high degree of value to student learning.

This document provides an important framework for educators to identify those essential conditions, analyze how their school or district is progressing through each dimension, communicate that progress back to community stakeholders and move on to the next step. We invite educators to use the reply card attached to request the companion document, *Technology in American Schools: Seven Dimensions of Progress, An Educator's Guide*.

The next step in the development of this framework will be in prototyping with schools, districts and states. Several education systems will be using it during the 1998-99 school year as the basis for reporting progress back to policymakers. This will require the identification of data sources and instruments for collecting evidence of progress associated with each dimension.

The authors invite educators and others to provide critiques and feedback on the framework, for, as with much work in education today, it is itself a work in progress. Our best hope is that this framework will assist educators and communities to understand and reach the full benefit of technology for learning for all children and youth across the country.

At a Glance:
The Seven Dimensions of Progress

A companion publication

(*Technology in American Schools: Seven Dimensions of Progress, An Educator's Guide*) has been developed with the educator in mind. This publication includes a continuum of progress indicators constructed for each of the seven dimensions. These continuums include three stages of progress: entry, adaptation and transformation, with transition steps designed to guide the educator from one stage to the next.

To request a copy of this companion document: send an e-mail to Cheryl Lemke, clemke@mff.org, fax a request to 310/998-2899, call 310/998-2825 or use the postcard in this document. You can also access both publications through the Milken Exchange Web site at www.milkenexchange.org.

1 Learners

FLUENCY:
Are learners proficient using technology and communication networks for whatever endeavors they choose?

STRENGTHENING THE BASICS:
Does this use of technology make it possible for the learner to acquire the basic skills with more depth?

DEVELOPING HIGHER LEVEL SKILLS:
Does this use of technology make it increasingly possible for the learner to engage in learning practices that lead to new ways of thinking, understanding, constructing knowledge and communicating results?

INCREASING RELEVANCY:
Are learners using contemporary technology, communication networks and associated learning contexts to engage in relevant, real-life applications of academic concepts? Does his/her work parallel the way in which professionals in the workforce use technology?

MOTIVATION TO LEARN:
Is quality access to technology and telecommunications increasing the intrinsic motivation of learners to learn?

RECOGNITION OF TRADEOFFS:
Are learners cognizant of the tradeoffs inherent in the application of technology in society as they make life choices in a global, technological society?

2 Learning Environments

LEARNING CONTEXT:
Are educators establishing a learning context that requires and enables students/student teams use of contemporary tools to research issues, solve problems and communicate results?

LEARNING CONTENT:
Do the standards, curriculum, instruction and assessment reflect the knowledge-based, global society of today? Are educators reflecting societal changes in school practice?

SCHOOL CULTURE:
Is the school culture one that encourages, enables and rewards educators individually and collectively to improve the learning and teaching processes through the effective use of technology and communication networks?

TECHNOLOGY ACCESS:
Do teachers and learners have sufficient access to productivity tools, online services, media-based instructional materials, and primary sources of data in settings that enrich and extend their learning goals?

INFORMATION AND COMMUNICATION:
Is the learning environment a place where the effective use of information and communication technology is modeled for and by students?

3 Professional Competency

CORE TECHNOLOGY FLUENCY:
Are the faculty and staff proficient, knowledgeable and current with contemporary technology?

CURRICULUM, LEARNING AND ASSESSMENT:
Has the teacher's fluency with technology translated into unique opportunities for students to learn more quickly, with more depth and understanding? Is the teacher's knowledge about technology's impact in his/her field of study reflected in the context of his/her students' learning?

PROFESSIONAL PRACTICE AND COLLEGIALITY:
Are teachers using technology and communication networks to advance their professional practice? Are teachers knowledgeable and current with the technology and its impact in their field of study and the larger society?

CLASSROOM AND INSTRUCTIONAL MANAGEMENT:
Through their use of technology and telecommunications are teachers creating learning contexts that require students to take on more independent roles in their own learning?

The Right Questions to be Asking...

The Right Indicators to be Measuring...

4 System Capacity

VISION:
Has the system engaged key stakeholders plus the broader community in defining and clearly stating a compelling vision and expectations for technology in schools? Is that vision embraced by the entire system?

LEADERSHIP AND PLANNING:
Has the system developed a comprehensive, long-term plan? Is there alignment between the plan for technology in schools and existent policies and practices (e.g., rules and regulations, fiscal priorities, operating practices, allocation of resources, investment in human capital and accountability)?

ENSURING CAPACITY:
Is the system ensuring that educators, communities and components of the system itself have the capacity to translate that vision into compelling, meaningful learning activities for children, youth and adults?

SYSTEMS THINKING:
Is there a team of leaders that embraces the vision and is in a position to facilitate the system changes that are necessary to reach that vision? Is the vision for improved learning through technology a design factor across the entire education system?

5 Community Connections

COMMITMENT:
Are key community stakeholders committed and involved in planning, implementing and evaluating the system's use of learning technology?

COLLABORATION:
Has the system identified the full range of mutually beneficial partnerships, exchanges and collaborations? Are any of these opportunities currently being developed?

CLARITY:
Do all technology partnerships, exchanges and collaborations include clear articulation of expectations, implementation plans, time lines and accountability systems?

COMMUNICATION:
Are there mechanisms for ongoing communication among partners and the broader community for the purposes of celebrating successes, building awareness, monitoring progress and encouraging wider participation?

6 Technology Capacity

INSTALLED BASE:
Do schools have an installed base of modern technology equipment (computers, calculators, digital cameras, projection devices, scanners, printer, etc.) to support the learning, communication, and administrative goals of the education system?

CONNECTIVITY:
Is the connectivity adequate to support current and rapidly growing demands created by the learning, communication, and administrative requirements of the education system?

TECHNICAL SUPPORT:
Is there adequate technical support to provide timely, expert trouble-shooting, technical assistance, ongoing maintenance, operation and upgrades?

CLIENT ORIENTATION:
Are client needs being met? Is there a high level of customer satisfaction?

FACILITIES:
Are the facilities within the system "technology-ready?" Do standards for facilities and infrastructure include technology requirements?

7 Accountability

DELIVERABLES AND BENCHMARKS:
Have clear goals been set, accompanied by logical implementation and change strategies, measurable objectives and associated metrics?

DATA COLLECTION/ INTERIM PROGRESS:
Is there a well designed data collection and analysis process that tracks progress, leads to data-driven decision making and provides evidence as to whether or not the intervention is leading toward the goals?

DATA-DRIVEN DECISION MAKING:
Is the data analysis appropriately informing decision making related to technology?

COMMUNICATION:
Is the communication plan keeping stakeholders informed and does it provide a feedback mechanism for continuous improvement?

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