The CEO Forum School Technology and Readiness Report

Key Building Blocks for Student Achievement

in the 21st Century:

Assessment Alignment Accountability Access Analysis





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The CEO Forum on Education and Technology

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Letter from the CEO Forum

In the global digital economy, technology is rapidly changing how people live and work. Now we need to harness technology to benefit our nation's schools, communities and, most importantly, students.

The CEO Forum views this final report as both a culmination and synthesis of five years of exploration on the impact of education technology. Since we published our last report The Power of Digital Learning: Integrating Digital Content in June 2000 and the policy paper Education Technology Must Be Included in Comprehensive Education Legislation in March 2001, schools and districts have continued to make remarkable progress acquiring hardware, establishing connectivity, ensuring teachers receive technology training and integrating digital content into the curriculum. Virginia, Texas and North Carolina have adopted versions of our STaR Chart in state technology and accountability programs.¹

Over the past ten years, the nation has invested \$37.8 billion in education technology and estimates project that spending will be \$5.8 billion in 2000-2001.² After much research and investigation, the CEO Forum asserts that the way to obtain the maximum return on our national investment in education technology begins with focusing technology on the key building blocks of student achievement assessment, alignment, accountability, access and analysis. In addition, the definition of student achievement must be broadened to include the 21st century skills that will be required for students to thrive in the future. In the same ways that technology helped revitalize American business, education technology offers great promise for improving education.

This report comes at a critical juncture. Given the intense national focus on student achievement and accountability, education technology provides a powerful arsenal of tools to improve student achievement and to create accountability frameworks based on continuous improvement. Some critics wrongly dismiss the investment in education technology as wasted when test scores do not immediately improve. These critics do not consider that technology was not deployed to fulfill educational objectives or that these assessments do not accurately measure educational objectives. This is a dangerous mistake. Our nation is already experiencing some of the benefits of technology in education. It is now time to take the final steps to integrate technology into instruction to improve student achievement and ensure technology benefits students, teachers, administrators, parents and communities nationwide.

We hope this report inspires schools and districts to take decisive action to ensure technology improves our nation's schools and prepares students to succeed in the increasingly competitive global economy.

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Executive Summary

The CEO Forum is committed to promoting and assessing the progress of technology in America's schools. Over the past five years, we have focused on establishing technology as an integral part of education. We urged schools to acquire hardware and establish connectivity. We made recommendations about the importance of teacher professional development and integrating digital content into the curriculum. In this final year we strove to go a dramatic step further.

The CEO Forum sought to answer how and why technology created a positive impact on education. In our investigation, we synthesized and developed case studies of best practice classrooms, analyzed existing research and interviewed education experts to identify the educational objectives that technology can help achieve for students, as well as the benefits to teachers, administrators, parents and the community. Our exploration identified several key findings that inform this report and our recommendations.

Education technology can improve student achievement. West Virginia experienced acrossthe-board increases in statewide assessment scores in basic skill areas. Eleven percent of the gain directly correlates to the Basic Skills/ Computer Education technology implementation 10 years ago.³ Studies have also demonstrated that not only does education technology improve student achievement but it also improves student's self-concept and motivation.⁴

Technology can have the greatest impact when integrated into the curriculum to achieve clear, measurable educational objectives. The Educational Testing Service conducted research on the impact of technology in an eighth grade math classroom. This study discovered that when computers were used to apply higher-order thinking concepts in math, and when teachers received sufficient professional development on computers, eighth graders gained a one-third grade level increase.⁵ When deployed appropriately, technology can change the way students think and learn, and thus, revolutionize education.⁶

As the communities around the country set educational objectives, the development of 21st century skills should be a key objective.⁷ In the rapidly changing economy, there is a corresponding shift in the skills and abilities that students will need to thrive in the future. These twenty-first century skills include digital literacy, inventive thinking, effective communication, teamwork and the ability to create high quality products. States have made remarkable progress instituting educational standards to drive education. As the development of 21st century skills becomes an important objective, standards and assessment should be updated to reflect and measure these abilities.

Assessment is not currently aligned with educational objectives, or adequately measuring 21st century skills. In many states, assessment evaluates only some of the state standards and emphasizes lower order skills. The Wisconsin Center for Education Research found that less than a dozen states could accurately claim that assessment was aligned with state standards.⁸ In addition, these traditional assessments do not measure the full range of 21st century skills that will be necessary for students to thrive in the future. States, districts and schools cannot expect to transform teaching and learning to reflect the demands of the 21st century while continuing to assess student achievement with outdated tests. Assessment must be aligned to measure the impact of instruction and the contribution of technology to that instruction. In addition, as schools and districts seamlessly integrate technology into the curriculum, the method of assessment should reflect the tools employed in teaching and learning. Technology provides valuable tools for enhancing assessment and should be integrated into assessment.

Measurement and continuous improvement strategies have not been widely implemented in schools and districts. The handful of institutions that have established measurement and continuous improvement strategies are demonstrating potent and positive results. Districts that have adopted the continuous improvement practices of Baldridge,9 such as Pinellas County, Florida, Brazosport, Texas and Oakland Schools in Michigan are demonstrating dramatic advances. Measurement and continuous improvement should be broadly adopted in schools and districts and should form the basis of accountability. Accountability should not rely solely on the results of high-stakes tests, particularly outdated tests that do not measure all the skills deemed most critical. Accountability should examine progress against educational objectives by examining multiple indicators across the educational system. Technology can help implement continuous improvement strategies to monitor and promote progress against objectives.

Our national emphasis should shift from whether or not technology should be used in education to *how* it should be applied to achieve educational objectives. Schools and districts should focus on the key building blocks for student achievement in the 21st century assessment, alignment, accountability, access and analysis—to ensure technology boosts student learning and improves education.

Year 4 Recommendations

Based on our investigation, the CEO Forum proposes six key recommendations to ensure the nation's investment in education technology improves student achievement and benefits education.

- Focus education technology investment on specific educational objectives.
- Make the development of 21st century skills a key educational goal.
- Align student assessment with educational objectives and include 21st century skills.
- Adopt continuous improvement strategies to measure progress and adjust accordingly.
- 5. Increase investment in research and development and dissemination.
- 6. Ensure equitable access to technology for all students.

Section I Student Achievement in the 21st Century

Student achievement must be improved in order to prepare students to succeed in the global economy. Many observers liken the need for a world class, highquality educational system to a national security issue. The United States can only remain a leading power in the global economy if it continues to ensure students will be prepared to thrive in the future.

> Currently, American students rank in the middle compared to international counterparts. In a recent survey of eighth grade students from 38 industrialized nations, the United States scored 18th in science and 19th in mathematics.¹⁰ In addition, other countries are expanding the integration of communication and information technologies to enhance student learning. Our nation must not rest complacently on our position as a world leader. There must be a national commitment to improve student achievement in order to ensure students are prepared to thrive in the digital age.

Education technology can help improve student achievement. Studies and research indicate that the impact of technology proves most powerful when focused on specific, measurable educational objectives, such as improved literacy.¹¹ In addition, students demonstrate higher levels of motivation and engagement when using technology, which also contributes to improved achievement.¹²

The nation must set the development of 21st century skills as critical to the success of

Students require higher levels of education to succeed in the

new knowledge-based economy. Today, 85 percent of jobs require

education beyond high school, compared to 61 percent in 1991.¹⁶

students. Today's student will require new abilities to thrive in the future. In the knowledge-based economy, knowing how to locate information quickly, weigh and evaluate information for bias and accuracy and synthesize and apply that information to solve problems will be a primary asset. These 21st century skills include digital age literacy, inventive thinking, effective communication and high productivity abilities.¹³

Technology can help the nation's schools deliver a world class education that will improve student achievement and develop 21st century skills. The nationwide education technology efforts should focus on how to apply technology's powerful tools to achieve educational objectives.

This section will:

- 1. Describe how education technology can help:
 - Improve student achievement
 - Develop 21st century skills and,
- Discuss how technology promotes student achievement by improving effectiveness for teachers, administrators, parents and the community.

Effective Use of Education Technology Can Help Improve Student Achievement

Education technology is a valuable tool to achieve educational objectives. Particularly when combined with the other key factors that increase achievement, such as clear, measurable objectives, parental and community involvement, increased time spent on task, frequent feedback and teacher subject matter expertise, technology can help deliver significant and positive results.

The United States has made great strides defining and elevating standards for student learning. In 1992, only 14 states had adopted academic standards, whereas today 49 states and over 50 national subject area groups, such as National Council of Teachers of Mathematics (NCTM), have content standards.14 Thirty-five states have now incorporated technology standards into academic standards.¹⁵ Standards are important because they clarify the core knowledge and skills that must be developed and measured in students. School systems define educational objectives in order to meet their local community's needs. Once school systems define educational objectives, all stakeholders should develop multi-year learning plans, combining the mission statement, technology plans and overall curriculum strategy in ways that link technology and digital content to objectives.

Although studies on the impact of technology in education are in their infancy, evidence indicates that educational technology changes the processes of teaching and learning. Technology transforms the learning environment so that it is student-centered, problem and project centered, collaborative, communicative, customized and productive. This

Targeted Reading Improvement ¹⁷

Results of a standardized test administered three years ago in Pinellas County, Florida identified that almost one-quarter of the middle and high school students could not read and understand their textbooks.

In an effort to reverse this disturbing trend, Pinellas County invested in comprehensive multimedia reading program and committed unprecedented resources to teacher professional development. The district also doubled class time and divided class sizes in half. Teachers assumed roles as facilitators, as students circulated through various workstations and tackled reading projects and tasks. One teacher, whose tenth grade students began the school year at a fourth grade reading level, saw an average of one grade level increase each semester. Additionally, the technology engaged and motivated students, so that many who had previously viewed reading as a chore became eager to learn.

An assessment program that evaluates student reading proficiency enables teachers across disciplines to target student abilities with appropriate instructional materials.

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Technology Can Help:

Improve Student Achievement

- Improved scores on standardized tests
- Increased application and production of knowledge for the real world
- Increased ability for students to manage learning
- Increased ability to promote achievement for special needs students
- Improved access to information that increases knowledge, inquiry and depth of investigation

Develop 21st Century Skills

- Improved basic skills (e.g., math, writing)
- Improved digital age literacy skills (e.g., technological, cultural, global awareness)
- Improved inventive thinking skills (e.g., creativity, problem solving, higher order, sound reasoning)
- Improved effective communication and interpersonal skills (e.g., writing, public speaking, teamwork, collaboration)
- Improved productivity skills (e.g., create high quality products)

creates the digital learning environments that improve student achievement and develop 21st century skills.

Improve Student Achievement

When applied to well-defined educational objectives, and integrated into the curriculum by trained teachers, education technology can produce dramatic results for students.

• Improved scores on standardized tests. Longitudinal research results of the statewide implementations of technology with large-scale integration across the curriculum in Idaho and West Virginia have shown a corresponding boost in test scores across subjects and disciplines.¹⁸ West Virginia, specifically, experienced across-theboard increases in all basic skill areas; 11 percent of the gain directly correlates to the Basic Skills/Computer Education technology implementation 10 years ago. BS/CE also proved to be more cost effective than other programs and effective with low-income and rural students.¹⁹ Students in Project Explore in Union City, NJ experienced boosts in standardized test scores in math.²⁰ Pump Algebra Tutor field studies (PAT) show significant student achievement gains relative to control classes: 15–25 percent improvement on standardized tests and 50–100 percent on assessments of problem solving.²¹ A four-year study demonstrated significant gains on the SAT-1 when students participated in an integrated technology curriculum, scoring 54 points higher in verbal and 34 points higher in math.²²

- Increased application and production of knowledge for the real world. One of the most dramatic ways education technology can make learning more dynamic and engaging is by forging real world contexts for academic exploration.23 Technology allows educators and students to augment curriculum with current information and timely study of real world events. Such authentic, relevant investigation encourages students to discover and understand practical implications and to produce knowledge with important applications. Studies have shown that students who employed simulations, microcomputer-based laboratories, and video to connect science instruction to real-world problems outperformed students who employed traditional instructional methods alone.24
- Increased ability for students to manage learning. With educational technology, the learning environment shifts from teachercentered to student-centered. In this new

student-centered environment, students are able to define individual objectives, create an accountability plan to reach them, and thus are more empowered to attain the state and local objectives set for them. This ownership and responsibility encourages students to be more directly engaged in their educational process. Additionally, technology offers many tools for self-assessment, so that students can monitor their own progress.

 Increased ability to promote achievement for special needs students. Several research studies offer evidence that educational technology can provide significant benefits for special needs students, including learning disabled, low achieving, special education and gifted students. A four-year study on SAT-1 performance in which students participated in an integrated technology rich curriculum demonstrated that learning disabled students gained 89 points in combined verbal and math scores.25 In writing, studies document the potential of software, expert systems, videodisc, hypermedia, optical character recognition, speech synthesis and speech recognition as effective tools for learning disabled students.26 Most notably, learning disabled students who employed speech recognition software to compose essays performed significantly higher than fellow learning disabled students with no assistance and approximately as well as their non-disabled peers.27

Targeted Reading Improvement (continued)

Pinellas County now allocates a third of its technology budget to teacher professional development. The district employs four resource teachers who visit schools daily to assist classroom teachers in integrating technology into the curriculum.

For more information on one-to-one e-learning, visit www.netschools.net.

Project Based Learning

Sir Francis Drake High School in San Anselmo, California determined 10 years ago that while the school successfully armed students with academic knowledge, it needed to prepare them with 21st century skills. Drake adopted a series of innovative project based learning initiatives to reverse that trend.

In one such program, an interdisciplinary academy called the ROCK (Revolution of Core Knowledge), ninth and tenth graders participate in a curriculum that combines art, science, social studies and English. The team of teachers ensures that the curriculum meets state standards, while also assigning projects that develop 21st century skills.

Students work on projects in groups and choose their own topics, which imparts greater ownership, engagement and ultimately boosts achievement. For example, a group of students investigating water:

- Employ technology to record a series of tests on the properties of water
- Track the connection between water conditions and weather and translate this into a visual pattern using a meteorology program

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Technology also provides additional opportunities, challenges and course offerings to gifted students.

• Improved access to information increases knowledge, inquiry and depth of investigation. When access to information becomes interactive and available on multiple levels through technology, students are able to deepen their knowledge, investigation and inquiry according to their needs and interests. No longer confined to the material in necessarily condensed textbooks, a student who wants to delve deeper into a subject can immediately find additional materials. This increases expertise, research skills and ultimately translates into improved student achievement.

When applied to meet clearly defined educational objectives, technology can help improve student achievement. Technology can also help prepare students with the newly evolving 21st century skills that will be essential to succeed in the future.

Develop 21st Century Skills

During the past decade, increased attention has focused on a new set of skills necessary to prepare students for life and work in the digital age. These 21st century skills build on and absolutely require strong traditional reading, writing and mathematical abilities.

21st Century Skills²⁸

Digital Age Literacy

- 1. Basic, Scientific, and Technological Literacy
- 2. Visual and information Literacy
- 3. Cultural Literacy and Global Awareness

Inventive Thinking

- 4. Adaptability/Managing Complexity
- 5. Curiosity, Creativity, and Risk Taking
- 6. Higher Order Thinking and Sound Reasoning

Effective Communication

- 7. Teaming, Collaboration, and Interpersonal Skills
- 8. Personal and Social Responsibility
- 9. Interactive Communication

High Productivity

- 10. Prioritizing, Planning, and Managing for Results
- 11. Effective Use of Real-World Tools
- 12.Relevant, High Quality Products

The current and future health of America's 21st Century Economy depends

directly on how broadly and deeply Americans reach a new level of

literacy—'21st Century Literacy'—that includes strong academic skills,

thinking, reasoning, teamwork skills, and proficiency in using technology.

The rapidly changing digital economy will require the workforce to continue to adapt to meet evolving challenges. In essence, today's students will have to learn how to learn. The ability to find information quickly and efficiently, to manipulate that information and apply it to solve problems and inform decisions will be a primary asset in tomorrow's workforce. To meet the demands of our global economy and a dramatically different society, there must be corresponding adaptations in our educational environments²⁹ to develop 21st century skills.³⁰

Educational technology provides educators with valuable tools to teach, develop and reinforce 21st century skills by dramatically altering the options for inquiry, analysis, and expression.

• Improved basic skills (e.g., math, writing) The same research that shows increases in standardized test scores also indicate that technology strengthens and reinforces traditional skills. Eleven percent of West Virginia's across the board gains in basic skills can be directly correlated to education technology. Idaho, PUMP Algebra, and Project Explore in Union City, NJ also experienced increases in academic skills. Project Explore also discerned a direct impact of technology on student writing skills.32 Similarly, studies demonstrated that students who wrote to real audiences regularly via the Internet and email gained marked improvements in their persuasive writing abilities both on and off

- National Alliance of Business³¹

the computer.³³ Another study indicated that the incorporation of a hypertext discussion tool into students' homework routine raised achievement over traditional discussion and text based homework. In addition, 68 percent of students reported that the hypertext tool increased the active engagement time spent on homework, a strong indicator of improved learning.³⁴

- Improved digital age literacy skills (e.g., technological, cultural, global awareness) These include language proficiency, namely, reading, writing, listening and speaking;35 scientific literacy, defined as the knowledge of science, scientific thinking, mathematics and the relationships between science, mathematics and technology;36 and, technological literacy, including competence in the use of computers, networks and digital content.37 The powerful tools of technology allow every student access to the vast resource of information about the world. Students can learn more about different cultures, immediately access scientific, geographic, social, cultural and historical information about our life on our ever-evolving globe. This information is relevant, up-todate, and authentic.
- Improved inventive thinking skills (e.g., creativity, problem solving, higher order, sound reasoning) The tailored, customized nature of digital content and technology challenges students to develop more effective problem

Project Based Learning (continued)

- Conduct research via the Internet to determine the social and economic implications of water around the world
- Survey different literary interpretations of water, and create a multimedia slide show to compare them and what they highlight about cultural differences
- Write and produce a multimedia presentation with maps, meteorology simulations, short video clips and scientific charts.

Student achievement continues to increase at Drake. The cumulative class grade point average rose from 2.6 to 2.9 from 1992-98. SAT scores improved from 450 to 560 verbal and 530 to 551 in math. The percentage of students who completed UC system requirements rose from 40 percent in 1993 to 62 percent in 1998. In 2000-01 the number of Drake graduates continuing to higher education increased to 82 percent.

For more information about Sir Francis Drake High School http://drake.marin.k12.ca.us

Rubrics for Project Based Learning http://pblmm.k12.ca.us/ PBLGuide/Mmrubric.htm

Administrators

Chapel Hill-Carrboro Schools in North Carolina reported that technology has dramatically changed how the district communicates. The district can now communicate with a wider variety of people, from parents to state administrators, more efficiently and effectively. This has led not only to a greater flow of information but also to an increased ability to serve core constituents. Technology's tools also help facilitate key datadriven decisions in student projections and redistricting when schools become overcrowded. Networks enable the district to make assessment information more immediately and readily accessible. On-line access to financial records and purchasing information streamlines district business practices.

For more information on Chapel Hill-Carrboro schools http://www.chccs.k12.nc.us solving, higher order and sound reasoning skills. Rather than just accept the information presented in a traditional textbook, students access their own information through research, evaluate their sources and arrive at conclusions supported by evidence.

• Improved effective communication and interpersonal skills (e.g., writing, public speaking, teamwork, collaboration)

Technology enables students to interact and communicate in more exciting and creative ways than ever before. The increased ability to communicate with experts both inside and outside school walls enhances the learning process.³⁸ Students in a school can work on projects together, or communicate and collaborate with experts at universities or other students across the country or in other nations. Students learn more sophisticated writing skills, tailoring their products to different audiences, and hone teamwork and collaboration skills.

• Improved productivity skills (e.g., create high quality products) Digital content and tools can be evaluated, revised and produced, allowing students to be increasingly creative and to fashion high quality interactive products.

These 21st century skills must be incorporated into state standards and assessment in order to develop these essential abilities.

Promote Student Achievement by Improving Effectiveness for Educators, Administrators, Parents and Community

Technology also improves student achievement by providing key benefits to stakeholders across the educational system. These benefits make each constituency more effective and therefore better able to prepare students to thrive in the digital age.

Stakeholder: Educators

Education technology can help teachers deliver instruction and target student needs more efficiently. Technology can also increase job satisfaction and reduce teacher isolation by encouraging communication with outside experts, peers, students, community members and parents. Some of the benefits teachers can realize include:

- Improved ability to meet student education outcomes
- Improved professionalism
- Improved instructional practices
- Increased communication and collaboration
- Improved efficiency and more constructive

time spent on administrative tasks Extensive professional development is required to integrate technology into the curriculum in the dynamic ways that increase student learning. And, as the nation struggles to recruit the 2.2 million new teachers in the coming years, education technology can also offer training opportunities and help increase retention.

Stakeholder: Administrators

Administrators face the challenge of managing schools while also responding to the demands of various constituencies. Through the effective use of technology, administrators demonstrate:

- Improved ability to make data driven decisions
- Improved ability to meet student needs
- Improved ability to define student objectives and measure performance against them
- Improved ability to manage district/school business practices
- Improved communication with key constituencies

Stakeholder: Parents and Community

Parental and community involvement in education is a key element to school success. Parents, as the single most important influence in a student's life, can help support and guide learning. In addition, schools are experiencing positive results by involving members of the community, including forging partnerships with businesses and encouraging interaction with experts at institutions of higher education. Businesses are becoming more involved in schools in order to help define and foster the skills and competencies they require in employees of the future.

Technology can foster benefits for parents and community, including:

- Increased family involvement in the education process
- Increased corporate and community involvement in the education process
- Increased interaction between K-12 and higher education
- Increased technology awareness and prepared workforce

Provide Core Fundamentals for Effective Education Technology

Certain conditions must be in place before education technology transforms teaching and learning in the creative ways that improve student achievement. In order to ensure an effective education technology system is in place, schools and districts must: provide sufficient and ongoing educator professional development for educators; fund education technology and ensure adequate technology infrastructure with flexibility for updates and reliable technical support; offer equitable availability of high quality courseware and digital content; and, provide local community and school leadership for the integration of technology into the curriculum.³⁹

The next section will describe how education technology can improve student achievement and education through effective alignment, assessment, accountability, access and analysis.

Parents and Community

When schools in Juneau, Alaska published electronic report cards to detail to parents how students met core objectives, this electronic linkage meant communication between teachers and parents soared. Parents reported that this information and communication invigorated their involvement in their children's education and targeted efforts to improve skills. http://www.jsd.k12.ak.us

Noting that 65 percent of jobs in Maine require technology skills whereas only two percent of students were using computers every day, the town's leading employer in Guilford, Maine realized that to secure a technology savvy workforce in the future the company would need to invest in the schools now. The company provided 175 laptops for students. They gave one to every student in the eighth grade, several for each seventh grade classroom, one for every teacher and a wireless network. The result was a transformation in education that benefited students, educators and ultimately the parents and community. For more information about Guilford contact Crystal Priest at cpriest@sad4.com

Section II The Building Blocks for Student Achievement

The same practices that revitalized American business fifteen years ago can be employed to invigorate education and create the world-class system our students deserve. In order to produce equally dramatic impact on education, the nation must ensure that technology's powerful tools are targeted at the key building blocks for student achievement—alignment, assessment, accountability, access and analysis—to transform the processes of teaching and learning and obtain positive results.

The educational system urgently requires modification in order to improve student achievement. In many schools and districts, the system is not adequately aligned with educational objectives. The CEO Forum believes that measurement matters and organizations can only manage what they frequently measure. However, too often, current standardized tests do not measure all the standards and educational objectives defined as critical and instead focus on lower order skills. In addition, the emphasis on high stakes tests overshadows the importance of ongoing student assessment in the classroom in order to track improvement and allow educators to revise and adjust instructional strategies accordingly.

The CEO Forum strongly supports accountability, but is concerned about accountability frameworks that rely solely on outdated, misaligned assessment. Accountability should be based on broader measures that look across the entire educational system and should adopt continuous improvement strategies to ensure progress. In addition, we must continue to address issues of access and equity. And we need more analysis on the impact of educational technology in the form of research and development.

If we focus technology on making the necessary changes to alignment, assessment, accountability, access and analysis, we will enhance the educational system to support standards and educational objectives and thereby promote student achievement.

This section will:

- 1. Outline the importance of **alignment**;
- Describe the modifications required to ensure assessment measures all standards and educational objectives;
- Urge schools and districts to establish accountability based on data-driven continuous improvement strategies;
- Discuss the critical issue of equitable
 access to education technology to ensure opportunity for all students; and,
- 5. Describe the need for more **analysis** and research.

Alignment

Ensure Curriculum, Technology Use and Assessment Support Standards and Objectives

An aligned system functions like a well-oiled, well-maintained car, with every part operating in concert to glide smoothly forward. However, a misaligned system is merely a collection of disparate parts. Each of these parts may operate independently but they are unable to gain momentum or make unified progress together.

One of the most serious obstacles to improving student achievement and instituting effective accountability is the lack of consistent alignment throughout the system. Educational objectives cannot be achieved unless the educational system is aligned to support them. State, district and local policies, educational programs and resource allotment must be aligned in order to attain goals. States, districts and schools must ensure technology use is aligned with standards, educational objectives, curriculum and assessment. As the standards, educational objectives, curriculum and assessment evolve technology use must be modified to support these goals.

The lack of alignment is most pronounced in student assessment. There is a widespread mismatch between standards and assessment. The Wisconsin Center for Education Research found that less than a dozen states could accurately claim that high stakes tests are aligned with standards.⁴⁰ Quality Counts 2001 reported that a study by Achieve indicated state standards and tests are not closely enough aligned, and in most cases measure only some of the standards and tend to focus on the less demanding and simpler skills.⁴¹

This misalignment undermines the effectiveness of standards. These assessments do not evaluate all the elements of student achievement we have defined as critical. In particular, they do not measure the 21st century skills that will be essential to success in the future. Partially, this is due to the continually evolving nature of standards in which assessment always lags behind the creation of standards. And as accountability becomes increasingly important, this, in part, explains why some educators "teach to the test" rather than to the standards.⁴² Schools can only be effective in enhancing teaching, learning and helping students achieve well-defined educational objectives when the standards, objectives, teaching, curriculum, resources, technology use and assessment are all aligned. The content and methods of assessment must be aligned to measure standards and objectives. Technology provides valuable tools to align the system to promote student learning by providing a means to monitor alignment and communicate these initiatives to the public.

Increasing Student Achievement

In 1989, failing in 44 of 52 state categories, Union City, NJ School District faced a school takeover. The district decided to tackle the challenges head-on and drastically reform their entire educational system. Union City created a plan to improve student achievement that included the extensive use of technology. They defined preferred educational objectives, created and revised curriculum to align with objectives and standards, and integrated technology seamlessly into the curriculum across all disciplines. Additionally, Union City established a network of expert teachers on the school building level to aid and mentor peers and, all educators participated in extensive professional development, as in-service training jumped from eight to 40 hours a year. Union City realized significant increases in standardized test scores and student rankings, transforming the district from a failing to a model school system.

For more information about Union City http://www.unioncity.k12.nj.us/ or "The Union City Story: Education Reform and Technology Students' Performance on Standardized Tests", Center for Children and Technology, 1998.

Assessment

Assessing 21st Century Skills

SRI International's Center for Technology in Learning (CTL) is currently investigating the power of technology to support assessments of 21st century skills and the impact of technology on student learning. One set of tasks measures students' skill in performing research on the Internet. The tasks present students with challenging real world problems that require students to search the Internet and evaluate sites for bias, comprehensiveness and relevance to a particular problem. Students then formulate and write a persuasive argument based on the research culled from those web sites.

Other projects measure collaboration, creativity and higher order thinking skills that will be essential in the future.

For more information on The Center for Technology in Learning assessment projects http://www.ed.gov/Technology /techconf/2000/means_paper. html. SRI expects these assessments available by summer 2001 http://www.sri.com

Measure All Standards and Objectives

Measurement is critical to progress. And yet, while states, districts and schools attempt to transform teaching and learning for the 21st century, the nation persists in measuring student achievement with outdated assessment that has remained largely unchanged throughout the last century. Too often, updated skills are measured by outdated tests using outdated technologies. These tests employ little new technology and are founded on behavioral psychological models of the early 20th century rather than the cognitive science of the 21st.⁴³

Assessment must be enhanced to ensure all the skills defined as important for students are measured, including the development of 21st century skills. Assessment should present students with relevant, challenging tasks that evaluate the full range of academic, performance and behavioral abilities. In addition, assessment should monitor higher order skills, rather than just reinforcing simpler ones. Otherwise, these outdated assessments can provide misleading information. For example, reading scores may rise, but students in fact may not be able to read comprehensively at grade level to evaluate information or to solve problems.⁴⁴

These outdated assessments and the intense focus on test-taking have led to a current back-

lash against testing. The UC system recently announced that it is considering abandoning the SAT for admission, out of a concern that students spend too much time on test preparation rather than learning the core concepts and skills. Several smaller schools, including Mount Holyoke, Bates and Bowdoin have made the SAT optional.⁴⁵ The CEO Forum believes that assessment should be an important part of teaching and learning, but that there is a pressing need to update assessment to reflect standards and educational objectives, and to measure the full range of student abilities, including 21st century skills.

Employ Technology in Assessment

As educational technology is integrated into the curriculum across all disciplines, technology should also be employed in assessment. A Boston College study demonstrated that the methods of evaluating student learning should reflect the tools used in instruction. This study showed that for a student accustomed to writing on a computer, responses written on computer scored substantially higher than those written by hand, demonstrating a relative success rate of 67 percent versus 30 percent.⁴⁶ By this logic, assessment should also include the use of graphic calculators, word processing and student self-assessment tools in computer-based testing.

If you are measuring how well students are achieving curriculum objectives, you

begin to force discussions within the schools and within the communities of how

well are we doing, how well do we want to do, how well are we improving

from year to year. Without that, those discussions are anecdotal.

-Nancy Vaughn, Coordinator, Information Systems Department, Texas Education Agency

Assessment can also include video, audio and animation, so that students are presented with more authentic, challenging and engaging tasks that measure higher order skills. Schools can also design assessment to include digital portfolios in which students assemble work on real world projects to give a more complete and holistic picture of learning and achievement over time. However, using technology more extensively and effectively must be predicated on equitable access to technology for all students.

Education technology can help develop a broader range of assessment tools in order to measure defined educational objectives and to link assessment to ongoing instruction.47 For example, if a state or school district defines an educational objective of developing students' ability to collaborate, then assessment should reflect and measure that objective. Oddly enough, while in early grades we report on whether children work and play well with others, and even though this is an even greater expectation for graduates, we stop measuring for this criterion beyond the early grades. However, technology can monitor and measure a student's collaborative and teamwork process and provide immediate feedback. Likewise, technology can help provide different kinds of assessment to serve diverse student needs.

Make Assessment an Ongoing Part of Instruction

Assessment should become an ongoing part of instruction to inform and enhance teaching and learning and to promote student achievement. Often, educators believe high-stakes assessment provides student information too late in the process to make a difference in teaching and learning. In this way, tests often become a means to assess schools,⁴⁸ to grade and even to punish schools, rather than being a means for educators to assess their students' learning process and improve student achievement. Technology can help facilitate the integration of more formative assessment. Rather than issuing assessment once a year and viewing assessment as isolated from the classroom, technology and student level tools can help make formative assessment an integral, iterative part of the teaching and learning process. This ongoing assessment strategy will lead both students and educators to view assessment as an important tool to offer feedback and to provide information for continuous improvement, rather than a measure to deliver rewards or punishment.49

The CEO Forum recommends that schools base accountability frameworks on continuous improvement strategies.

Developing Ongoing Assessment

Twenty school systems in Tennessee have adopted a research based assessment system to provide feedback throughout the school year to improve student learning. Testing occurs periodically and presents criterion-referenced items that are aligned with standards, curriculum and the annual assessment. Teachers, students and parents access tools to measure mastery. This information allows teachers to modify instruction and teaching strategies over time.

Reports are delivered instantaneously over the web. Bedford County Schools discovered the system was tremendously helpful in measuring and pinpointing student progress against specific skills and standards. In Memphis City Schools, teachers found that the timely, easy to interpret report information offered a road map to utilize instructional time more effectively to strengthen student skills.

For more information on the ThinkLink Learning Feedback System http://www/thinklinklearning.com

Accountability

Continuous Improvement: Employing Data to Target Instruction

One of the ways schools can employ measurement and continuous improvement to improve student learning is by analyzing data and targeting professional development to adjust instructional strategies.

 As part of a statewide focus on improving reading, Maryland analyzed the aggregate data on Maryland School Performance Assessment Program (MSPAP) to identify an area for improvement in reading instruction. Although students scored well on reading for literary understanding, students across grade levels struggled to meet the standard to read for information in expository articles and materials.

In a pilot program, the MD state professional development department conducted targeted training with school principals to change instruction. Principals assumed the role of instructional leaders, training teachers to instruct students to support arguments with material from the text.

For more information http://www.msde.state.md.us/

Establish Measurement and Adopt Continuous Improvement

The CEO Forum supports the nationwide shift to accountability in education. However, we are deeply concerned that some accountability frameworks focus solely on the results of outdated high-stakes tests that are not aligned with standards and educational objectives.

We believe strongly that measurement matters. Organizations can only manage what they frequently measure. Therefore, the CEO Forum recommends that accountability should be based on measurement of progress against educational objectives across the entire system and that schools and districts should adopt continuous improvement strategies to ensure success. Information technology provides schools and districts with exciting new tools to assess their practices on a continuous basis, and to modify and amend as appropriate. Schools and districts can employ technology to monitor progress, generate and analyze performance data, measure, gather evidence and study what works, redirect instructional strategies and communicate initiatives to the broader community.

Districts and schools that have embraced continuous improvement by adopting *Baldridge* quality principles demonstrate the positive impact of these practices. These districts and schools continually measure progress against educational objectives. Their success attests to the power of continuous improvement for targeted results and excellence.

Adopting continuous improvement is an iterative and evolving process. It begins with defining educational objectives, linking measurement to those objectives and creating plans to achieve them. For example, if a school system identified an educational objective of improving literacy, the system would have to develop a tool to evaluate progress over time. Not only would progress be measured by scores on assessment, schools would evaluate the difficulty of the books students read and the ability to evaluate sources for bias, information and accuracy. At each stage, as administrators and teachers evaluated success and identified areas for improvement, stakeholders would revisit objectives and measures, revise

The CEO Forum supports the nationwide shift to accountability in education.

However, we are deeply concerned that some accountability frameworks

focus solely on the results of outdated high-stakes tests that are not

aligned with standards and educational objectives.

action and instructional strategies and continue to study, reflect and evaluate. Accountability based on measurement and continuous improvement vigilantly monitors progress against educational objectives and revises and adjusts actions according to what works.

As part of accountability and continuous improvement, schools will undertake program evaluation on the impact of education technology itself. As technology is integrated into the curriculum to achieve objectives, measurement must occur on an ongoing basis and evaluations of technology's effectiveness must look beyond standardized test scores. Although standardized test scores are one gauge of student, teacher and school progress with education technology, they are insufficient. Multiplechoice tests do not measure the full range of 21st century behavioral and performance skills. Therefore many school districts and schools have adopted multiple indicators to evaluate the effectiveness of technology. Many schools measure student progress against the International Society for Technology (ISTE) standards for technology literate students.⁵¹ Other schools examine whether technology use correlates to

reduced absenteeism, students' completion of more complex projects and tasks, greater number of students opting for more difficult courses, decreased drop out rates, increases in college application and acceptance and boosts in job offers after graduation.

Schools and districts should also measure across the educational system to determine the benefits of education technology. Certain key indicators influence student achievement, such as parental involvement and teacher professional development. Education technology can help parents become more involved in their individual student's education by communicating with teachers and viewing student assignments, attendance and work. Teacher professional development can be delivered via technology and made accessible anytime, anywhere. These and other key benefits should be measured as part of continuous improvement efforts.

Continuous Improvement: Employing Data to Target Instruction

A research project linking teacher professional development and student learning in urban schools compared and analyzed assessment to identify student difficulties with specific standards, skills and concepts. In one example, responses demonstrated that students had not fully grasped the curriculum on mapping and watersheds. Professional development workshops targeted this subject matter and resulted in significant improvement on test scores.50

For more information http://www. personal.umich.edu/~fishman/ papers/FishmanNARST2001.pdf

Access

Measure Equity

The American education system is dedicated to educating all students at the highest possible level of excellence. As such, one of the most important areas for the nation to continue to target for improvement is equity in access to technology. Education technology can help equalize opportunity for all students, regardless of race, ethnicity, gender, geographic location and economic status. Conversely, the absence of technology resources limits the possibilities for education and may perpetuate and even solidify economic disparities, class advantage and racial bias. The U.S. Department of Commerce defined this barrier in resources as the digital divide. Many now compare this to a knowledge divide, as only some students have access to the tools and learning that develop the requisite 21st century skills.

The nation has made tremendous progress in equalizing access to technology in our nation's schools. In 1999, the classroom connection at schools reporting 71 percent or more students eligible for free or reducedprice school lunch remained stagnant at 39 percent versus 63 percent at all public schools. By 2000 this connection rate at the most disadvantaged schools rose to 60 percent, still below the 77 percent average but a marked improvement. Similarly, the students per instructional computer with Internet access rose from 17 in 1999 to nine in 2000 at the nation's poorest schools, versus nine in 1999 and seven in 2000 at all public schools.⁵²

Examinations of equity in access to technology must also measure professional development and digital content. Studies indicate that even when access to technology and connectivity exists, students may have unequal learning experiences. African American and Hispanic students were significantly less likely than their white counterparts to use computers for the more sophisticated simulation and application but were more likely to employ computers for drill and practice.⁵³ In 1997, only 17 percent of black and 20 percent of Hispanic students used a computer in school, compared to almost 40 percent of white students. And only 12 percent of Hispanic students and 15 percent of black students accessed the Internet in school, compared with 21 percent of white students.54

It is imperative that federal and state governments continue to monitor and eliminate inequities in access to education technology.

Analysis

Call for More Research

The CEO Forum believes that there needs to be a major increase in research and development for education technology. There is growing evidence of the clear link between the effective use of technology to achieve educational objectives and student achievement. More research and development should be done to demonstrate how and why.

In 1999, the nation spent more that \$300 billion on public K-12 education, but invested less that 0.1 percent of that amount to determine what educational techniques actually work, or to investigate ways to improve them.⁵⁵ In stark contrast, Kellogg, the maker of breakfast cereals, spends two percent of its resources on research and development to improve its product.⁵⁶ Clearly educational research remains grossly underfunded. This must be rectified in order to guide and inform education and to ensure excellence for our nation's students.

Determine Role of Technology in Student Achievement

The federal government, states, foundations and institutions of higher education should embark on longitudinal studies of student achievement and the effectiveness of technology. While some initial studies prove technology can be effective in improving education when applied to meet well defined objectives, the system needs more information on how, when and for what periods of time technology can help student achievement.

Develop Tools to Measure 21st Century Skills

We must develop assessment tools that measure 21st century skills. Education technology can assist in developing a broader range of assessment tools in order to measure preferred educational objectives, especially 21st century skills, and to link assessment to ongoing instruction.57 Technology allows schools to include authentic tasks and projects with real world relevance in assessment. As technology is integrated across the curriculum, the means of assessment should reflect the tools employed to teach skills during instruction, which will require that technology is employed on an increased number of assessments. All of this will require additional investment in research to develop and deploy new student measures. The CEO Forum recommends that these new assessment tools to measure 21st century skills be easy to administer and score, and its indices as readily understood and communicated as our current system.

Disseminate Best Practices

Sharing success stories on the impact of technology in education will enable schools nationwide to profit from the expertise of peers. The dissemination of these best practices will support widespread effective use and assessment of education technology. In addition, more research should be done on the most efficient and powerful ways to share these best practices in order to maximize the positive impact of technology on student learning and achievement.

Key Recommendations

1

Focus education technology investment on specific educational objectives

- School districts should involve stakeholders, including parents and teachers, business leaders and community members, in identifying educational objectives and developing strategic technology and educational plans.
- Administrators and educators should ensure measurable educational objectives guide technology plans.
- State and local administrators should set multi-year goals for education technology and update them on an ongoing basis as they learn what works.
- Schools should ensure technology is integrated across the curriculum and that standards, educational objectives, resource allocation and assessment are aligned.

2

Make the development of 21st century skills a key educational goal

- Business leaders should work with educational and federal and state government organizations to define the evolving criteria of 21st century skills.
- By 2002, every state should incorporate 21st century skills into standards.

3

Align student assessment with educational objectives and include 21st century skills

- By 2003, every state should match assessment to the new standards that include 21st century skills.
- Schools and districts should align curriculum, technology use, resource allocation and assessment to support standards and educational objectives.
- States, schools and districts should ensure that technology is used in assessment, so that the methods of assessment accurately reflect the tools employed in instruction.

4

Adopt continuous improvement strategies to measure progress and adjust accordingly

- States, districts and schools, with assistance of corporate leaders and with reference to the work of organizations such as Baldridge, should adopt continuous improvement strategies that measure progress against educational objectives and adjust the use of resources and practices accordingly.
- School and district administrators should adopt more than one measure to evaluate learning and the effectiveness of educational practices that integrate technology.
- School districts should communicate progress to parents, students and community.

States, districts and schools across the country are beginning to experience the positive impact technology can have on education. The CEO Forum recognizes that the evaluation of the impact of technology in education is in its infancy. There needs to be a national imperative, state and local commitments and widespread investment and adequate support for research and development to take the critical next steps. The CEO Forum believes the nation must focus on the key building blocks for student achievement—alignment, assessment, accountability, access and analysis—in order to ensure technology improves the processes of teaching and learning for all students. Only then will the country truly benefit from the power of education technology to improve student achievement and develop 21st century skills. To reach these goals, the CEO Forum offers six recommendations.

5

Increase investment in research and development and dissemination

The federal government, states, institutions of higher education and foundations should fund additional research and development into how technology can improve student achievement, into creating new assessment tools to measure 21st century skills, and should disseminate best practice information on technology use and assessment.

Impact of Technology on Student Achievement

We need data on how technology can help achieve educational objectives, in what situations, with which students and over what period of time.

- Technology companies must be willing to participate in external evaluations of their products and services.
- Federal and state government must make funds available for program evaluation.
- Institutions of higher education must work with schools on longitudinal studies of what is being used in the classroom.
- Districts must revise curriculum decisions based on data and research.

- Teachers must use the data to revise classroom instruction.
- School boards must communicate to parents that classroom activities will change based on research and results.

Assessment Tools to Measure 21st Century Skills

We need meaningful measures of 21st century skills. Performance skills cannot be adequately measured by paper and pencil and multiple-choice assessment.

- Federal and state government and states should commit investment dollars.
- Institutions of higher education and foundations should focus on research that results in new assessment tools.
- Schools and districts should pilot new assessment tools and provide feedback on how to improve them.

Dissemination on Best Practice Use and Measurement

 The federal government, states, institutions of higher learning and foundations should develop mechanisms to share best practices in order to accelerate the national process of learning how to use technology most effectively.

6

Ensure equitable access to technology for all students

Federal and state governments must continue to measure and address issues of inequity in education technology, and create funding mechanisms that ensure equitable access to hardware, connectivity, professional development and digital content for all students.

Appendix A: Year 4 Snapshots

Hardware

Educators require the essential tools to enhance learning in the 21st century. Providing adequate hardware creates the basic infrastructure necessary in order to transform teaching and learning in the creative ways that ensure technology helps improve student achievement.

Nationwide Progress in Educational Technology

Since the inception of the CEO Forum, we have tracked America's progress in acquiring education technology. Significant progress has been made towards implementing a technology infrastructure, training teachers and acquiring high quality digital content. However, these snapshots also identify critical areas for improvement.



SOURCE: QUALITY EDUCATION DATA, 2001.

Connectivity

The combination of hardware and networks opens an unprecedented level of communication and collaboration and links students to vast reservoirs of information and experts.



SOURCE: NATIONAL CENTER FOR EDUCATION STATISTICS, 2001.



SOURCE: NATIONAL CENTER FOR EDUCATION STATISTICS, 2001.

Professional Development

Well-trained teachers are the key to creating dynamic digital learning environments. Students with more highly skilled and talented teachers score higher, every time.⁶⁵ Of teachers who received 11 or more hours of training on integrating technology into the curriculum in the previous year, 48 percent say that they rely on software, digital content, and the Internet to a "very great" or "moderate" extent. Schools and districts must continue to make the commitment to professional development by providing the necessary support, resources and time for teachers to learn both how to use technology, and more importantly, how to integrate it into the curriculum to achieve educational objectives.



SOURCE: MARKET DATA RETRIEVAL, 2001.



SOURCE: NATIONAL CENTER FOR EDUCATION STATISTICS, 2000.

Teacher Use of Technology by Type of Training Received⁶⁸

Teachers who received training in the same year were more likely to use technology.

No training								
use to a moderate extent								22%
use to a very great extent								3%
Basic technology skills								
use to a moderate extent								22%
use to a very great extent								3%
Curriculum integration							i	
use to a moderate extent			;		1			32%
use to a very great extent								5%
Both basic skills and Curriculur	n integra	tion						
use to a moderate extent								32%
use to a very great extent								8%
	0%		10%	20%		30%	4	0%

SOURCE: EDUCATION WEEK, BUILDING THE DIGITAL CURRICULUM, 1999.

Digital Content

Digital content makes a vast reservoir of information, ideas and experts available at any time, from anywhere. This provides powerful resources and tools to teachers and students.

	Stud	lents	Use of	f Comp	outers	at Sc	hool ⁶⁹			
Do research for assignments										96%
Write papers										91%
Do homework										62%
Help visualize new concepts										60%
Practice things learning in class										57%
Get homework help										44%
Keep up with news										43%
Study for tests										39%
Do non-school activities (e.g., download music):										35%
Take exams										20%
Communicate with class- mates about schoolwork										19%
Communicate with teachers										14%
Communicate with students in other towns about schoolwork										7%
Take courses with students from other schools										5%
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%

SOURCE: EDUCATION WEEK/MDR/HARRIS INTERACTIVE POLL OF STUDENTS AND TECHNOLOGY, 2001.

	Freque	Frequency of Student Computer Use For Schoolwork ⁷⁰							
Almost every day									
4th grade						9	%		
8th grade						14	•%		
12th grade						21	.%		
Once or twice a week	· · ·	· · ·		· · ·	· · ·	· · ·			
4th grade						20)%		
8th grade						24	•%		
12th grade						28	3%		
Once or twice a month	· · · ·								
4th grade						17	?%		
8th grade						28	3%		
12th grade						30)%		
Never or hardly ever									
4th grade						55	;%		
8th grade						34	•%		
12th grade						22	2%		
	0%	10%	20%	30%	40%	50%			

SOURCE: EDUCATION WEEK, BUILDING THE DIGITAL CURRICULUM, 1999.



SOURCE: NATIONAL CENTER FOR EDUCATION STATISTICS, 2000.

A Call for Equity

Education technology should be used to eliminate barriers, not to create new ones. As discussed on p. 19, vigilantly addressing issues of equity has led to tremendous progress. For example, in 1999 the connectivity rate in classrooms at our nation's poorest schools remained stagnant at 38 percent versus 63 percent in all public schools. In 2000 this rate had grown to 60 percent, still below the 77 percent in all public schools but a marked improvement. We still have further to go. We must continue to measure equity in access to ensure all students can leverage the essential tools for the digital age.

Internet Access According to School Characteristics72

	Percent with Inf	of Public S ternet Acce	Schools ss		Percent with Int	Percent of Classrooms with Internet Access			Students per Instructional Computer with Internet Access		Internet available to students at times other than regular school hours
School Characteristics	1994	1997	1999	2000	1994	1997	1999	2000	1999	2000	
All Public Schools	35%	78%	95%	98%	3%	27%	63%	77%	9	7	54
Instructional level		:	:	:	:					:	:
Elementary	30%	75%	94%	97 %	3%	24%	62%	76%	11	8	46
Secondary	49%	89 %	98%	100%	4%	32%	67%	79%	7	5	80
Size of enrollment											
Less than 300	30%	75%	96%	96 %	3%	27%	71%	83%	6	4	49
300 to 999	35%	78%	94%	<mark>98</mark> %	3%	28%	64%	78%	9	7	53
1,000 or more	58%	89 %	96%	99 %	3%	25%	58%	70%	10	7	79
Metropolitan status					1					1	
City	40%	74%	93%	96 %	4%	20%	52%	66%	11	8	56
Urban Fringe	38%	78%	96%	98%	4%	29%	67%	78%	9	7	58
Town	29%	84%	94%	98%	3%	34%	72%	87%	8	6	45
Rural	35%	79%	96%	99 %	3%	30%	71%	85%	7	5	53
Percent minority enrollment	t										
Less than 6 percent	38%	84%	95%	<mark>98</mark> %	6%	37%	74%	85%	7	6	46
6 to 20 percent	38%	87%	97%	100%	4%	35%	78%	83%	8	6	59
21 to 49 percent	38%	73%	96%	<mark>98</mark> %	4%	22%	64%	79%	9	7	54
50 percent or more	27%	63%	92%	96 %	3%	13%	43%	64%	13	8	61
Percentage of students elig	ible for free	e or reduce	d price lunc	h							-
Less than 35 percent	39%	86%	95%	99 %	3%	37%	73%	82%	8	6	58
35 to 49 percent	36%	81%	<mark>98</mark> %	99 %	2%	40%	69%	81%	9	6	47
50 to 74 percent	31%	71%	96 %	97%	4%	27%	61%	77%	10	7	52
75 percent more	20%	62%	89%	94%	2%	22%	38%	60%	17	9	56

SOURCE: NATIONAL CENTER FOR EDUCATION STATISTICS, 2001.

Digital Differences

Surveys indicate that even when equitable access to education technology exists, students may have unequal learning experiences. Many teachers in poorer schools rely on technology to reinforce basic skills, rather than to support higher order thinking and the full range of 21st century skills. This inequity must be addressed.

Percent of Teachers Assigning Activities⁷³



Multimedia Projects								
Percent of stude	nts eligible	for reduce	d price lunc	h				
Less than 11 %				55%				
11 to 30 %				46%				
31 to 49 %				47%				
50 to 70 %				44%				
71% or more				33%				
	0%	20%	40%	60%				

	Internet	Research		
Percent of stude	nts eligible	for reduce	ed price lun	ch
Less than 11 %				61%
11 to 30 %				56%
31 to 49 %				54%
50 to 70 %				45%
71% or more				35%
	0%	20%	40%	60%

	Drills			
Percent of stude	nts eligible	for reduce	d price lunc	h
Less than 11 %				49 %
11 to 30 %				54%
31 to 49 %				45%
50 to 70 %				51%
71% or more				51%
	0%	20%	40%	60%

	Solve Pro	blems/A	nalyze Da	ta
Percent of stude	nts eligible	for reduced	d price lunc	h
Less than 11 %				47%
11 to 30 %				55%
31 to 49 %				50%
50 to 70 %				49%
71% or more				43%
	0%	20%	40%	60%

Graphical Presentations									
Percent of students eligible for reduced price lunch									
Less than 11 %				52%					
11 to 30 %				45%					
31 to 49 %				43%					
50 to 70 %				41%					
71% or more				37%					
	0%	20%	40%	60%					

Demonstrations/Simulations									
Percent of students eligible for reduced price lunch									
Less than 11 %				44%					
11 to 30 %				41%					
31 to 49 %				41%					
50 to 70 %				35%					
71% or more				36%					
	0%	20%	40%	60%					

SOURCE: NATIONAL CENTER FOR EDUCATION STATISTICS, 2000.

Budget Allocation

The vast majority of education technology investment, 63 percent, is still devoted to hardware and connectivity. 17 percent of technology budgets were dedicated to professional development in 1999-0, an increase from 14 percent in 1998–9.⁷⁴ However, this still lags behind the **CEO** Forum recommendation of 30 percent. Digital content expenditure made up 20 percent of 1999–o budgets, an increase from 14 percent in 1998–9.⁷⁵ The CEO Forum recommends schools and districts spend 25 percent on digital content.The continued success of the integration of technology into the curriculum will depend on broad availability of digital content and welltrained teachers. As schools establish a robust technology infrastructure, the CEO Forum recommends these institutions increase investment in professional development and digital content.





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Glossary

21st Century Skills

The new set of skills necessary to prepare students for life and work in the digital age. These skills include digital literacy, inventive thinking, effective communication and high productivity abilities

Accountability

Holding people and institutions responsible for their, or their institution's performance in meeting defined objectives

Alignment

The clear lineation and linkage of instructional resources and tools (including technology) and assessment to support standards and educational objectives

Assessment

The means of evaluating student performance, skills and knowledge. Assessment takes place in two forms. Formative assessment occurs on an ongoing basis as part of the instructional process and provides opportunities to revise or adjust instruction accordingly. Summative assessment occurs at the end of projects, courses or grade levels and can include educator, school or district designed evaluations and tests, or state-mandated standardized short answer and multiple-choice tests

Continuous Improvement

The ongoing process of planning, measuring, monitoring, evaluating and adjusting actions based on results to enhance student and school performance

Digital Content

The digitized multimedia material that calls upon students to seek and manipulate information in the collaborative, creative and engaging ways that make digital learning possible. It includes video on demand, software, CD-ROMs, web sites, email, on-line learning management systems, computer simulations, streamed discussions, data files, databases and audio

Digital Learning

This educational approach integrates technology, connectivity, digital content and human resources. When implemented correctly, it builds on the unique, dynamic characteristics of digital content to create productive and engaging learning environments that improve student achievement and develop 21st century skills

Digital Literacy

The literacy skills for the digital age include language proficiency, namely, reading, writing, listening and speaking; scientific literacy, defined as the knowledge of science, scientific thinking, mathematics and the relationships between science, mathematics and technology; and, technological literacy, including competence in the use of computers, networks and digital content

Educational Objectives

Specific performance goals for individuals or institutions, usually defined by schools or districts to meet community needs

Education Technology

The method and material used to achieve an educational objective. This can include more traditional education technologies such as blackboards and pencils, or the full range of tools, voice, video, data, digital, network and information systems available. For the purposes of this report, and with respect to rapid and continued innovation, the CEO Forum defines education technology broadly so that it is not device driven or limited to the technologies now available

High Stakes Testing

Assessment with serious consequences attached, such as promotion or graduation

Measurement

The process of evaluating multiple indicators across the educational system to gauge progress and to identify areas for improvement

Program Evaluation

The appraisal of an educational initiative, whether a technology plan or instructional strategy, to determine effectiveness

Research and Development

Studies by institutions of higher education, foundations and school systems necessary to determine the most effective educational strategies and assessment tools

Stakeholders

Constituents with a vested interest in student achievement, including educators, administrators, parents, community members and business leaders

Standards

- Content Standards
 Educational guidelines that define subject-matter benchmarks for student learning
- Performance Standards
 Complementary educational guidelines that clarify the content standards by defining what students should be able to do in addition to what students should know

Student Achievement

The attainment of articulated objectives for students, measured through a variety of identified instruments, that result in excellence and the ability to thrive in the rapidly changing world Founded in 1996, the CEO Forum on Education & Technology is a unique fiveyear partnership between business and education leaders who are committed to assessing and monitoring progress toward integrating technology in America's schools. The CEO Forum hopes to ensure that the nation's students will achieve higher academic standards and will be equipped with the skills they need to be contributing citizens and productive workers in the 21st century.

The CEO Forum Four Year Agenda

Year 1: The School Technology and Readiness Report: From Pillars to Progress (October 1997) The first report issued by the CEO Forum focused on the importance of integrating all the elements of education technology, from hardware and connectivity to professional development and content.

- STaR Chart, a self-assessment tool for schools to gauge progress toward integrating technology to improve education.
- STaR Assessment, a benchmark measure of national progress toward integrating technology in schools.

Year 2: Professional Development: A Link to Better Learning (February 1999) This secondyear report focused on educator professional development, the foundation for effective use of technology in education.

- Ten Principles for Effective Professional Development
- STaR Chart Update
- STaR Assessment Update

Year 3: The Teacher Preparation STaR Chart: A Self-Assessment Tool for Colleges of Education (January 2000) This self-assessment tool enabled colleges of education to determine their institution's level of readiness in preparing tomorrow's teachers to integrate educational technology into instruction.

The Power of Digital Learning: Integrating Digital Content (June 2000) This report offered a vision for digital learning and focuses on the actions that schools, teachers, students and parents must take to integrate digital content into the curriculum to create the learning environments that develop 21st century skills.

- Creating a Digital Content Strategy
- STaR Chart Update

Year 4: Education Proposals Must Be Included in Comprehensive Education Legislation (March 2001) This policy paper provided recommendations regarding education technology for the federal government.

Key Building Blocks for Student Achievement in the 21st Century: Assessment, Alignment, Accountability, Access and Analysis (June 2001) The final CEO Forum report focuses on the important educational objectives that can be achieved through the effective use of education technology. It also highlights the changes in alignment, assessment, measurement, continuous improvement and research needed to ensure technology produces positive results in education.

• STaR Chart Update

Organizing Principles

- All students must graduate with the technology skills needed in today's world and tomorrow's workplace.
- All educators must be equipped to use technology as a tool to achieve high academic standards.
- All parents and community members must stay informed of key education technology decisions confronting policymakers, administrators and educators.
- All students must have equitable access to technology.
- The nation must invest in education technology research and development.





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More information from the CEO Forum is available on the World Wide Web. www.ceoforum.org