S. HRG. 107–117

EDUCATION TECHNOLOGY

HEARING

BEFORE A

SUBCOMMITTEE OF THE

COMMITTEE ON APPROPRIATIONS

UNITED STATES SENATE

ONE HUNDRED SEVENTH CONGRESS

FIRST SESSION

SPECIAL HEARING

JULY 25, 2001—WASHINGTON, DC

Printed for the use of the Committee on Appropriations

Available via the World Wide Web: http://www.access.gpo.gov/congress/senate

U.S. GOVERNMENT PRINTING OFFICE

74–895 PDF WASHINGTON : 2002

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512–1800; DC area (202) 512–1800
Fax: (202) 512–2250 Mail: Stop SSOP, Washington, DC 20402–0001

COMMITTEE ON APPROPRIATIONS

ROBERT C. BYRD, West Virginia, *Chairman*

DANIEL K. INOUYE, Hawaii	TED STEVENS, Alaska
ERNEST F. HOLLINGS, South Carolina	THAD COCHRAN, Mississippi
PATRICK J. LEAHY, Vermont	ARLEN SPECTER, Pennsylvania
TOM HARKIN, Iowa	PETE V. DOMENICI, New Mexico
BARBARA A. MIKULSKI, Maryland	CHRISTOPHER S. BOND, Missouri
HARRY REID, Nevada	MITCH MCCONNELL, Kentucky
HERB KOHL, Wisconsin	CONRAD BURNS, Montana
PATTY MURRAY, Washington	RICHARD C. SHELBY, Alabama
BYRON L. DORGAN, North Dakota	JUDD GREGG, New Hampshire
DIANNE FEINSTEIN, California	ROBERT F. BENNETT, Utah
RICHARD J. DURBIN, Illinois	BEN NIGHTHORSE CAMPBELL, Colorado
TIM JOHNSON, South Dakota	LARRY CRAIG, Idaho
MARY L. LANDRIEU, Louisiana	KAY BAILEY HUTCHISON, Texas
JACK REED, Rhode Island	MIKE DEWINE, Ohio

TERRY SAUVAIN, *Staff Director*
CHARLES KIEFFER, *Deputy Staff Director*
STEVEN J. CORTESE, *Minority Staff Director*

SUBCOMMITTEE ON DEPARTMENTS OF LABOR, HEALTH AND HUMAN SERVICES, AND EDUCATION, AND RELATED AGENCIES

TOM HARKIN, Iowa, *Chairman*

ERNEST F. HOLLINGS, South Carolina	ARLEN SPECTER, Pennsylvania
DANIEL K. INOUYE, Hawaii	THAD COCHRAN, Mississippi
HARRY REID, Nevada	JUDD GREGG, New Hampshire
HERB KOHL, Wisconsin	LARRY CRAIG, Idaho
PATTY MURRAY, Washington	KAY BAILEY HUTCHISON, Texas
MARY L. LANDRIEU, Louisiana	TED STEVENS, Alaska
ROBERT C. BYRD, West Virginia	MIKE DEWINE, Ohio

Professional Staff
ELLEN MURRAY
JIM SOURWINE
MARK LAISCH
ADRIENNE HALLETT
ERIK FATEMI
ADAM GLUCK
BETTILOU TAYLOR *(Minority)*
MARY DIETRICH *(Minority)*

Administrative Support
CAROLE GEAGLEY
CORREY DIVINEY *(Minority)*

CONTENTS

EDUCATION TECHNOLOGY

WEDNESDAY, JULY 25, 2001

U.S. SENATE,
SUBCOMMITTEE ON LABOR, HEALTH AND HUMAN SERVICES, AND EDUCATION, AND RELATED AGENCIES,
COMMITTEE ON APPROPRIATIONS,
Washington, DC.

The subcommittee met at 9:40 a.m., in room SD–106, Hon. Tom Harkin (chairman) presiding.

Present: Senators Harkin and Specter.

OPENING STATEMENT OF SENATOR TOM HARKIN

Senator HARKIN. The Subcommittee on Labor, Health, Human Services, Education and Related Agencies will come to order.

This hearing is about what we are going to be doing in the 21st century to improve the learning skills for all of our kids from the earliest age on through all of their education.

Five or 10 years ago people would argue about whether or not technology could really help students learn. I think we have settled that argument. It is not about whether, it is about how. The "how" I think will continue to change as we develop new processes and we get new technologies. The computers are expensive. But I think they are worth the money and they are making differences.

When technology is used well, it can transform education and it can open minds to new worlds of learning and brighten a child's future. I have seen how technology can make a difference and obviously, I am going to see more this morning about how technology can make a difference.

A few months ago I visited Council Bluffs where some of our schools are using a Federal grant and a donation from The Waitt Family Foundation to integrate technologies into primary grades. Ms. Maxwell is here to talk about that.

I have also visited—and they were demonstrating something here this morning—the Iowa City-based Break Through to Literacy, which is using technology for young kids for literacy improvement and training. I think they are now in over four thousand schools, if I am not mistaken.

So this technology is booming. It has touched virtually every aspect of schools and it is not just about putting computers in the classroom and then walking out the door. I think, as Ms. Maxwell will explain, the project that we are doing in Iowa is changing the way teachers teach, and the way students learn, even for kids who are 6 years old.

I was amazed myself to watch what these little first-graders were doing with the technology they had and how the teachers were interacting with them. Of course, the teachers had to go through some training and be brought up to speed on it. This one teacher said, "You know, I knew how to use a computer before, but I did not know how to tell other people and other kids how to use this." And so the training was vital. I think technology can get students excited about school and give them instant access to the Internet, visualize concepts in a way textbooks cannot, open all new worlds. It can give all students first-first century skills they need to succeed in a technology-based workplace.

I could go on for hours, but I think I am probably preaching to the choir.

I will say one other thing. As many of you know, I am the chief sponsor of the Americans With Disabilities Act. I have been involved in the Individuals with Disabilities Education Act idea for a long time, 25 years, and the other thing that I have seen happen with technology is how it has really improved the learning skills and abilities of special needs kids. Perhaps that had not been thought of before. But these technologies now are enabling kids with learning disabilities to do more than they have ever done before and I would also like to talk about that today.

How can the Federal Government help make these things happen for schools all over the country? In particular, what can this committee do as it writes its appropriation bills to encourage the effective uses of technology? The education budget is going to be tight, so we have to be strategic about how and where we spend our money. I guess the basic question is should we put it all in block grants as the President has asked or should we set aside for priorities like teacher training and community technology centers and other things I am going to hear about today.

We are fortunate to have an outstanding panel of witnesses to discuss these topics. We are also lucky to have with us several of the most innovative and successful education technology programs in the country.

Immediately following our panel discussion, I invite you all to move to the back of the room where you can view, along with me, demonstrations of these exciting technologies.

I will leave the record open for any opening statements that any other Senators may have. I welcome our witnesses, Dr. Margaret Honey, vice president at The Education Development Center and Director for EDC Center for Children and Technology. Dr. Honey has been working in the educational technology field for more than 20 years. She received her B.A. in Social Theory from Hampshire College and M.A. and Ph.D. from Teachers College, Columbia University.

We have Gail Maxwell, whom I mentioned earlier, a technology strategist for the Griswold Iowa Community School District, where she is administering the Federal Technology Innovation Challenge Grant for two elementary schools.

Cheryl Williams is the president of the International Society for Technology in Education and vice president of Education for the Corporation for Public Broadcasting.

Thomas Gann is the director of Strategic Alliances for Global Education and Research Business Unit of Sun Microsystems and previously had directed the company's Asia Pacific business programs.

David Rose, Doctor of Education, is co-director of The Center for Applied Special Technology, a not-for-profit organization whose mission is to expand educational opportunities for individuals with disabilities through the development and innovative uses of technology.

PREPARED STATEMENT

This is a very distinguished panel of witnesses. We welcome you here and before we start, I would recognize our distinguished ranking member, and good friend, the Senator from Pennsylvania, Senator Specter.

[The statement follows:]

PREPARED STATEMENT OF SENATOR TOM HARKIN

Good morning. This hearing of the Senate Labor, Health and Human Services, and Education Appropriations Subcommittee will now come to order.

Five or ten years ago, people would argue about whether technology helps students learn. "All these computers are so expensive," they'd say. "Are they really worth the money? Will they really make a difference in student achievement?"

Well, I'm glad to say we've gotten past that debate. The key is not whether technology can help students, but how it's used.

When technology is used well, it can transform education, open young minds to new worlds of learning, and brighten a child's future.

I've seen how technology can make a difference. A few months ago, I visited Council Bluffs, Iowa, where some schools are using a federal grant and a donation from the Waitt Family Foundation to integrate technology into the primary grades.

Technology has touched virtually every aspect of these schools. They didn't just put some computers in the classrooms and leave. As Gail Maxwell, one of our witnesses, will explain, this project is changing the way teachers teach and students learn—even for kids who are just 6 years old. It was amazing to watch what those little 1st graders could do.

Technology can get students excited about school. It can give them instant access to the Internet. It can help them visualize concepts in ways that textbooks can't possibly match. It can open up a whole new world for students with disabilities. And it can give all students the 21st century skills they need to succeed in a technology-based workplace.

I could go on for hours, but I know I'm preaching to the choir.

What I'd like to talk about today is how the federal government can help make those things happen for schools all over the country. In particular, what can this committee do as it writes its appropriations bill to encourage effective uses of technology?

As you may know, the education budget is going to be extremely tight this year. So we have to be strategic about how and where we spend the money. Should we put it all in block grants, as the president wants to do, or should we set some aside for priorities like teacher training and community technology centers?

We're fortunate to have an outstanding panel of witnesses to discuss these topics with us today, and I'll introduce them in a moment. We're also very lucky to have with us a number of the most innovative and successful education technology programs in the country. Immediately following our panel discussion, I invite you all to move to the back of the room, where you can view demonstrations of their exciting techonolgies.

OPENING STATEMENT OF SENATOR ARLEN SPECTER

Senator SPECTER. Thank you very much, Mr. Chairman, and I commend you for convening this very important hearing on technology in education. Senator Harkin and I have passed the gavel of the chairmanship of this subcommittee several times—12 years,

he prompts me—I am not sure that I like it better when he is the chairman or when I am the chairman. But come to think of it, I think I like it better when I am the chairman—only slightly, because we have a real bi-partisan partnership. I learned a long time ago that if you want to get anything done in Washington, you have to cross party lines. We have taken the lead on this subcommittee with enormous increases in funding on education as well as other matters within the—he wants to be sure I am properly identified on television—somebody might think I was Senator Harkin and could cost him votes in the election cycle.

We have taken the lead on very substantial increases in funding. Last year we added more than $6 billion to the Federal share on funding and the addition to the National Institutes of Health is really a landmark achievement with what NIH has accomplished in so many lines.

But you hear so often the slogan just do not throw money at education, do not throw money at anything. So that when you move into the technology line, then we have a real opportunity to leverage the funds we have and to try to solve some of the extraordinarily difficult problems we face in education today.

I had the benefit of schooling in a very small town in Kansas, Russell, Kansas. Bob Dole and I come from the same little town, and there were 98 graduates in my high school class. The debating team was a great opportunity and classes were small.

It is a little hard for me to take a look at what goes on in my current hometown, Philadelphia, with the problems they have in the educational system. There has been a lot of time and attention, but I think this issue of technology really may be the key. It really may be the secret.

I would like to pay special recognition to Carnegie Learning, a Pittsburgh-based firm, and one of the companies participating in the demonstration. For the past 17 years Carnegie Learning has been doing research and the past 10 years testing that research in the classroom. Their learning-by-doing curricula unites students and teachers and helps them learn together. And to recognize Miss Libby, vice-president of Sales, who was here. Just permit me that one parochialism.

But I want to congratulate and thank all of you for being here today and to express my regrets that we have in an adjoining room down the hall, actually on the second floor, a hearing on a dairy compact, which is a matter that I have to attend.

One of the difficulties of this job is that we have many, many hearings at the same time and it requires us to leave somewhere we prefer to stay, but I will follow the hearing with the transcript and through staff, and I thank you, Mr. Chairman.

Senator HARKIN. Thank you very much, Senator Specter.

I would like to now turn to our panel of witnesses. We will start with Dr. Honey.

I will ask if you could limit your statements to 5 to 7 minutes. If it runs over a little bit, we will understand, but if you could do that, it will leave time for some discussion and to see the displays afterwards.

Again, Dr. Honey, welcome, and please proceed.

I might just add that all of your statements will be made a part of the record in their entirety.

STATEMENT OF DR. MARGARET HONEY, VICE PRESIDENT AND DIRECTOR, EDUCATION DEVELOPMENT CENTER, CENTER FOR CHILDREN AND TECHNOLOGY

Dr. HONEY. Thank you.

It is a pleasure to be here this morning and in my remarks, I have been asked to speak briefly to three questions. First, what are the educational benefits of technology?

Second, what do we now know about how to build quality software applications?

And third, what should be the Federal Government's role in advancing educational technology?

After more than two decades of research, we now have decisive evidence that technology use can lead to positive effects on student achievement.

Statewide technology implementation efforts have resulted in improved test scores when well-designed and well-implemented technologies that support literacy, mathematic and science learning result in gains for students.

With respect to a growing national concern, like accountability, technologies have critical roles to play in helping educators to use data effectively and efficiently to improve instruction.

Companies like Wireless Generation are pioneering the development of diagnostic software applications that teachers can use in their everyday work to collect learning data that can lead to direct improvement in instruction.

We have also had the pleasure of working with the Library of Congress in developing their American Memory Fellows Program, which brings together teachers to create and publish classroom applications that use the Library's digitized collections in American history.

Technologies also create new opportunities for students to express and communicate their ideas. A team of fifth and sixth graders created a website called "On My Math Applications" which includes information and exploration of math in connection with music, stock market investments, travel, economic projections and history. This site and hundreds more like it have been created by students participating in an academic contest called ThinkQuest.

But technology in and of itself is never the answer. In more than 20 years of work, we have learned a single lesson over and over again. No matter how well designed the technology and how creative individual teachers, if a school is not prepared to use technology well, there will be little impact on students' learning.

Leadership, clear educational objectives, sustained professional development, adequate technology resources and evaluations that lead to continuous improvement are the ingredients that make technology work.

And we need to realize that it takes time for schools to learn to use technology as well.

Several decades of experimentation and research have also taught us three critical lessons about effective software design. To be effective, educational software must build upon what we know from research on learning. It must address real challenges teachers

are facing and make the task at hand easier to accomplish and it must be applicable across multiple contexts and multiple curricula by addressing core learning challenges.

Finally, what role should the Federal Government play? Federal involvement is critical in two respects, leadership and funding.

The U.S. Department of Education's Office of Educational Technology has provided critical leadership in helping promote a comprehensive vision for the effective use of technology in our schools. This office has defined and administered programs, convened national and regional conferences to bring together State and local technology leaders, compiled and disseminated a well-researched library of best practices and put forward two national technology plans.

Last year the Department of Education released the findings of the expert technology panel. Of the two exemplary and five promising programs that were identified, the Federal Government originally funded all seven. The Department's Challenge Grant Program, along with the National Science Foundation, made these and many other innovations possible.

Other Federal initiatives are helping introduce technologies into schools of education so that our newest teachers will be effectively prepared to make technology a substantial partner in the learning process.

And, of course, the E-Rate Program has resulted in a wiring of over 1 million classrooms, the vast majority of which are in high poverty communities.

I hope you will conclude from my testimony that we are getting measurable results from educational technology. That we know what it takes to make new technology programs successful, and that the Federal Government must continue to provide leadership and funding without which this progress would not have occurred.

I would further hope that as leaders you have the vision to realize that the progress we have made has prepared us for an entirely new level of leadership and funding. That it may be time to conceive of an education initiative on the scale of the Apollo program or the Genome project. Indeed, I would submit that the top rating given to education issues in every public opinion poll suggest that the American people have never been more ready to be captivated by such a vision.

PREPARED STATEMENT

Within this decade it will be possible to develop the technologies and to expand the capacity of the educational system such that every day of school from kindergarten to college will be an intellectual adventure. It will be possible for our teachers to see clearly how each child is progressing and it will be possible to activate all the resources in school, at home and in our communities to ensure that no child is left behind.

If we do this, then every other great goal we might set for this country will surely follow.

Thank you.

[The statement follows:]

PREPARED STATEMENT OF MARGARET HONEY

My name is Margaret Honey and I am a Vice President at the Education Development Center, an educational not-for-profit, and I direct EDC's Center for Children and Technology. Our Center, established in 1980, was one of the first groups to undertake research and development on educational technology. I have been affiliated with the Center for 16 years and have been working in the education and technology field for more than 20 years. It is a pleasure to have an opportunity to address the committee.

I was asked to speak to the question of what we now know about technology's effectiveness as a teaching and learning tool and how we might think about the role of the Federal government in this enterprise. I have divided my remarks into three sections, each of which addresses a specific question:

1. What have we learned about the educational benefits of technology?
2. What have we learned over several decades of experimentation about how to build quality educational technology applications?
3. What should be the federal government's role in advancing educational technology?

BENEFITS OF EDUCATIONAL TECHNOLOGY

After more than two decades of research on the benefits of educational technology we now have decisive evidence that technology use can lead to positive effects on student achievement.[1] Specifically,

—In studies of large-scale statewide technology implementations, these efforts have been correlated with increases in students' performance on standardized tests.[2]

—Software supporting the acquisition of early literacy skills—including phonemic awareness, vocabulary development, reading comprehension, and spelling—can support student learning gains.[3]

—Mathematics software—programs like Carnegie Learning's Algebra Tutor, for example, that supports experimentation and problem solving—enables students to embrace key mathematical concepts that are otherwise difficult for many students to grasp.[4]

—Scientific simulations, microcomputer-based laboratories, and scientific visualization tools have all been shown to result in students' increased understanding of core science concepts.[5]

In addition, we know that technologies offer teachers and students opportunities that would otherwise be extremely difficult to realize in classroom contexts. Assessment, information access, collaboration, and expression are four areas where educational technologies demonstrate particular promise—and there is a broad consensus among school reformers regarding the central importance of these issues for improving student achievement.

Assessment

With respect to assessment, technologies have critical roles to play in helping educators to use data effectively and efficiently to improve instruction.[6] Companies like Wireless Generation are pioneering the development of diagnostic software applications that teachers can use in their everyday work to collect learning data that can lead to direct improvement in instruction. These applications can now reside on handheld computers like Palm Pilots, making it possible for teachers to chart student progress over time, identify where a student is having trouble, and modify instruction to help the student succeed. If our goal is for schools to use data to enable all students to achieve, then these kinds of diagnostic assessment tools are essential in helping teachers to do this work effectively.

---

[1] *2000 Research Report on the Effectiveness of Technology in Schools*. Software Information Industry Association. Washington, D.C.

[2] Mann, D., Shakeshaft, C., Becker, J. and Kottkamp, R. *West Virginia Story: Achievement Gains from a Statewide Comprehensive Instructional Technology Program*. Milken Exchange on Educational Technology, 1999.

[3] *2000 Research Report on the Effectiveness of Technology in Schools*. Software Information Industry Association. Washington, D.C.

[4] Koendinger, K., Anderson, J. *Pump Algebra Project: AI and High School Math*. Human-Computer Interaction Institute, Carnegie Mellon University, 1999.

[5] CEO Forum. *Key Building Blocks for Student Achievement in the 21st Century*. Washington, D.C. June, 2001.

[6] Brunner, C. and Honey, M. *Report to the Atlantic Philanthropic Trust*. EDC Center for Children and Technology. July, 2001.

Information access

During the past decade we have seen a tremendous growth in the range of archival materials that are available on the web. Digital archives have been and continue to be developed by museums, libraries, scientific and other archival institutions. These collections are among the most exciting resources driving educational interest in information and multimedia technologies. Collections as diverse as National Center for Supercomputing's Astronomy Digital Image Library and the holdings of the Louvre Museum have been digitized and provide classroom teachers and their students with access to artifacts and information previously available only to specialized scholars or academic researchers. They give teachers and students opportunities to work with an extraordinary array of authentic materials and up-to-date information that would not find their way into classrooms were it not for the growth and development of technologies.[7] Access to this data literally gives all schools—regardless of their geography or wealth—the potential to have libraries of unparalleled collections and connections to the same materials that our nation's greatest universities have.

Collaboration

Technologies offer many other opportunities to teachers and students. Consider, for example, the issue of collaboration. Teachers are the one professional group in our society that is largely isolated from colleagues during the working day. Phones in classrooms are uncommon at best and shared planning time for teachers is rare in most schools. Much of our work at the Center for Children and Technology has focused on using the communications capabilities of the Internet to develop new models for teacher professional development and collaboration that have the potential for providing teachers with networks of support.

We have worked, for example, with the Library of Congress to develop the American Memory Fellows program.[8] This program brings teams of teachers together in both virtual and face-to-face learning communities to develop, test, and publish creative classroom applications that make use of the Library's digitized collections in American History. Teachers learn how to work with primary-source archives that include photographs, pamphlets, films, and audio recordings from American history and culture. Technology makes access to these materials possible and enables teachers to work together to build lesson plans and curriculum for their classrooms.

Expression

Technologies also create new opportunities in which kids can express and communicate their ideas. It is no longer uncommon for schools to encourage reports in multimedia format or for students to build web resources that can be used by others. A team of fifth and sixth graders, for example, created a website called "Online Math Applications" which includes information and exploration of math in connection with music, stock market investments, travel, economic projections and history. They use online calculators, stories, problems, simulations and demonstrations to teach their peers. This site and hundreds more have been created by students participating in an academic contest called ThinkQuest.™[9]

The importance of context

There are thousands of examples of work being done in schools with technology that lead to important gains in student learning. What is most important, however, is that we recognize that technology will not result in measurable gains unless the school context is receptive and well organized for technology use. In more than 20 years of work, we have learned a single lesson over and over again—school context is a critical factor in determining the degree to which educators can creatively and deeply use technology. No matter how well designed the technology, how comprehensive the training program, and how creative individual teachers are, if they work in a context that is not supportive of and receptive to the use of technology for instructional purposes the technology will have little impact on students' learning.[10]

We have learned through our work with numerous school districts around the country, that if technologies are to be used to support real gains in educational out-

---

[7] Honey, M. et.al. (1996). Digital archives: Creating effective designs for elementary and secondary educators. Invited white paper prepared for the United States Department of Education. http://www.ed.gov/Technology/Futures/honey.html

[8] http://memory.loc.gov/ammem/ndlpedu/index.html

[9] http://www.thinkquest.org/

[10] Honey, M., Culp, K.M., & Carrigg, F. (2000). Perspectives on technology and education research: Lessons from the past and present. *Educational Computing Research* (23) 1.

comes, then five factors must be in place and these factors must work in concert with each other.[11]

1. There must be leadership around technology use that is anchored in solid educational objectives. Simply placing technologies in schools does little good. Effective technology use is always targeted at specific educational objectives; whether for literacy or science learning, focus is the key to success.

2. There must be sustained and intensive professional development that takes place in the service of the core vision, not simply around technology for its own sake, and this development must be a process that needs to be embedded in the culture of schools.

3. There must be adequate technology resources in the school including hardware and technical support to keep things running smoothly.

4. There must be recognition that real change and lasting results take time.

5. And, finally evaluations must be conducted that enable school leaders and teachers to determine whether they are realizing their goals, and how to adjust if necessary.

EFFECTIVE SOFTWARE DESIGN

Several decades of experimentation and research in developing educational software have also taught us some critical lessons. To be effective educational software must accomplish three things. It must:

—Build upon what we know from research about the key areas of knowledge acquisition, including both concepts and procedures, which children must master. Carnegie Learning's Algebra Tutor and Wireless Generation's Diagnostic Reading Assessment are both examples of software applications that are substantially grounded in research about how students learn algebra and how they master early literacy strategies.

—Address real challenges that teachers are facing, and make the task at hand easier to accomplish. The most effective software is always developed in collaboration with teachers and is based on extensive research done in classrooms, to ensure both usefulness and effectiveness. IBM's Reinventing Education Partnerships are a very promising model in this regard.

—Be applicable across multiple contexts and multiple curricula by addressing core learning challenges, not curriculum specific skills and tasks. It should not matter, for example, whether my district uses a balanced literacy curriculum or one that emphasizes teaching phonics. Effective educational software should support the processes associated with learning how to read and be applicable regardless of any specific instructional approach.

THE ROLE OF THE FEDERAL GOVERNMENT

The Federal role in educational technology is critical in two respects: leadership and funding. The U.S. Department of Education's Office of Educational Technology has provided critical leadership in helping promote a comprehensive vision for the effective use of technology in our schools. This office has defined and administered programs, convened national and regional conferences to bring together state and local technology leaders, compiled and disseminated a well-research library of best-practices information, and put forward two national technology plans.[12]

The Federal Government has also been an essential partner in technology funding. Thirty-five percent of all educational technology funding has been federal. This is a remarkable figure when compared to the 6.6 percent that the federal government contributes overall to education funding.[13] And the results have been pronounced. Last year the Department of Education released the findings of the Expert Technology Panel. Of the two exemplary and five promising programs that were identified, the federal government originally funded all seven. The Department's Challenge Grant Program along with the National Science Foundation made these and many other innovations possible. Other federal initiatives are helping introduce technology into schools of education so that our newest teachers will be effectively

---

[11] Honey, M., & McMillan-Culp, K. (2000). Scale and localization: The challenge of implementing what works. Paper presented at Wingspread conference, "Technology's Role in Urban School Reform: Achieving Equity and Quality," Racine, WI., October 12–14, 2000.

[12] President's Committee of Advisors on Science and Technology, Panel on Educational Technology. "Report to the President on the Use of Technology to Strengthen K–12 Education in the United States. 1997." The National Educational Technology Plan. "E-Learning: Putting a World-Class Education at the Fingertips of All Children." U.S. Department of Education. December, 2000. Web-Based Education Commission. *The Power of the Internet for Learning: Moving From Promise to Practice*. Report to the President and Congress of the United States, 2000.

[13] http://www.schooldata.com/pr22.html

prepared to make technology a substantial partner in the learning process. And, of course, the E-Rate program has resulted in the wiring of over one million classrooms, the vast majority of which are in high poverty communities.[14]

CONCLUSION

I hope you will conclude from my testimony that we are getting measurable results from educational technology, that we know what it takes to make new educational technology programs successful, and that the Federal Government must continue to provide the leadership and funding without which this progress would not have occurred.

I would further hope that the leaders in this room have the vision to realize that the progress we have made has prepared us for an entirely new level of leadership and funding—that it may be time to conceive of an education initiative on the scale of the Apollo Program or the Genome Project. Indeed, I would submit that the top rating given to education issues in every public opinion poll suggests that the American people have never been more ready to be captivated by such a vision.

Within this decade it will be possible to develop the technologies and to expand the capacity of the educational system, such that every day of school—from kindergarten through college—will be an intellectual adventure tailored to each student's particular learning needs. It will be possible for our teachers to see clearly how each child is progressing, and it will be possible to activate all of the resources in school, at home, and in our communities to ensure that no child is left behind.

If we do this, then every other great goal we might set for this country surely will follow.

Thank you.

Senator HARKIN. Thank you, Dr. Honey. And now we will turn to Gail Maxwell of Griswold Community School District.

STATEMENT OF GAIL MAXWELL, TECHNOLOGY STRATEGIST, GRISWOLD COMMUNITY SCHOOL DISTRICT, GRISWOLD, IOWA, AND THE WAITT/HARKIN INNOVATION TECHNOLOGY CHALLENGE GRANT

Ms. MAXWELL. Thank you. It is a pleasure to be here today to discuss the integration of technology in our schools. I am a technology strategist for the Griswold Community School District in Griswold, Iowa. It is a small rural consolidated district with approximately seven hundred students.

A little over a year ago we received the Waitt Harkin Technology Challenge Grant. It is a 3-year grant in conjunction with the Walnut Grove Elementary School in Council Bluffs, Iowa and the Loess Hills Area Education Agency in Council Bluffs.

The objective of our grant is to improve student learning through the effective use of technology in the primary grades in both a rural and urban setting. The key components of our grant are staff development to build a vision of what technology should be in our schools. Awareness and utilization of teaching strategies that create student-centered project-based classrooms and the effective use of equipment and software.

The objectives of our two elementary buildings in Griswold are to enhance reading comprehension and interactive and independent writing.

When we began our grant we decided that we did not want to isolate students by putting just one student at a computer. We wanted to encourage hands-on learning and we wanted to develop higher learning/thinking skills. With this in mind, we purchased one laptop with wireless access for every two students so that they

[14] CEO Forum. *Key Building Blocks for Student Achievement in the 21st Century*. Washington, D.C. June, 2001.

would work in pairs or small groups and software that was conducive to student-based, project-based learning.

We have ongoing staff development, which is very important. We meet 1 day a month, at least, and often 3 to 4 days during the summer.

My position is to provide the staff development for the teachers, assist them in planning and integration and be available daily in the classrooms with the teachers and students.

The evaluation of our grant is done by the Metiri Group of Los Angeles, California. They are looking to establish a correlation between project activities and student learning. They are also measuring the impact of this project on the educator's vision for the role of technology in the curriculum, advances in teacher proficiency using teaching strategies involving technology and changes in the learning environment.

We have had many successes in this first year of our grant. The most important success is the enthusiasm for learning shown by the students. They took immediate ownership and pride. They stay on Task Monger when using their laptops. Their reading levels are higher when they are engaged in accessing information with them. And their writing has become more proficient.

The teachers began to do in-depth projects such as WebQuest involving research skills, collaboration and higher-level thinking.

When we began this project, our objectives were to improve reading comprehension and writing skills.

At the end of our first year, we saw growth not only in those areas, but also in what are called 21st century skills; collaboration, research skills, technology skills and student self-direction. These are now a focus for our grant and will be included in the evaluation. The students in the grant were far better in these skills than the students not involved in our grant, who only used a lab on a scheduled basis. What works for technology in the schools is having it readily available in the classrooms on a daily basis.

One of the main obstacles that we met was time. It takes a lot of time for teachers to plan and create lessons and implement them fully in a day that is already very full for them.

We also had an obstacle in time and resources for teachers to attend professional conferences and workshops or visit innovative sites integrating technology.

Another obstacle that we met was seamless integration. The teachers often felt they were giving up necessary teaching to incorporate technology instead of using the technology to teach the necessary skills. This improved during the year and will continue to improve with time, use and further training.

We will face our biggest obstacle at the end of the grant. We will have students that have had state-of-the-art technology available to them in their classrooms, but at the end of our 3 years, we will be faced with obsolete laptops, software that needs to be upgraded and limited funds to carry on the project because of declining enrollment, cuts in State funding and looming budget cuts.

Because of our successes and our obstacles, these are our recommendations for the Federal Government.

Please assume a leadership role in providing the vision of what effective, seamless integration should be in the schools. Stress the

importance of teaching 21st century skills in conjunction with basic learning. Continue to fund innovative projects, not just equipment and connectivity, but personnel and training. Then continue to fund those projects, if successful, so schools are not forced to discontinue them. Establish pilot sites throughout the country that effectively and seamlessly integrate technology in the classrooms. Provide beginning teachers entering the field with pre-service opportunities in technology integration. Continue to fund the E-Rate, which provides discounts for Internet and phone services and frees money that can be used for technology in other ways.

Because of the funding of the Federal Government and The Waitt Family Foundation, we have many plans for our remaining 2 years of the grant. We will continue to work towards that seamless integration of technology in our classrooms. We will publish our work, equalize the access of students that do not have computers at home, stay on the cutting edge of instructional technology and assist other schools in technology integration.

PREPARED STATEMENT

We hope the Federal Government continues to provide the vision, leadership and funding in educational technology so that all schools can provide equal access to technology and that they use this technology correctly as a tool to enhance learning in the classroom.

I invite any of you to visit our classrooms in Griswold to see technology integration in action.

Thank you.

[The statement follows:]

PREPARED STATEMENT OF GAIL MAXWELL

Mr. Chairman, and Members of the Subcommittee, it is a pleasure to be here today to discuss educational technology. I am a technology strategist for the Griswold Community School District in Griswold, Iowa, and am coordinating the Waitt/Harkin Technology Grant in our two elementary schools. Our district is a consolidated rural district with an enrollment of approximately 700 students. The Waitt/Harkin Grant is a three-year Technology Innovation Challenge Grant, matched by the Waitt Family Foundation. It is shared by Walnut Grove Elementary School in Council Bluffs, Iowa, and Lewis and Elliott Elementary Schools from the Griswold Community School District, and is in cooperation with the Loess Hills Area Education Agency of Council Bluffs, Iowa. We have just completed the first year of this grant. The project has created demonstration sites where best practices in technology utilization are integrated into primary classrooms in both rural and urban settings. In the Lewis and Elliott Elementaries the first year of the grant began with our multi-age classrooms, which are combination first and second grades. We will add third grade during the second year and fourth grade during the third year while maintaining the technology in the previous classrooms.

The main objective of the grant is to improve essential student learning through the effective integration of technology into the existing curriculum. The purpose is to demonstrate the effective use of technology in the primary grades. There is not much research available to show the effectiveness of technology in primary grades so this grant is valuable in providing needed data.

The key components of the grant are:

—Staff Development to build a vision of what is possible

—Awareness and utilization of teaching strategies that create student centered, project based classrooms (Project-based learning is a learner-centered teaching approach that draws on aspects of task-based learning, project work, and self-instruction. This type of instruction is built around activities or projects designed by the teacher or student.)

—Effective use of equipment and software

The objectives for Lewis and Elliott Elementary Schools are:

—Students will engage in activities, which will enhance reading comprehension.

—Students will engage in activities, which will enhance interactive and independent writing.

Strategies have been developed to meet these objectives.

Decisions for the grant were based on research done prior to implementation. In our research we found that there were arguments that technology use in the primary grades would cause isolation by putting students in front of computers to do skill-based software. Students at that age need socialization, hands-on learning, and the development of thinking skills. Taking that into consideration we provided one wireless laptop for every two students in our multi-age classrooms so they would work in pairs or small groups. We wanted to make sure the technology was not used by itself but as a tool to improve student learning. Our major focus is student-based, project-based learning so the software available is conducive to this focus. The laptops are wireless so the students have access to the Internet, the server, and the printers from anywhere within the buildings. This access makes a large change in the learning environment, making integration of technology much easier. We have digital cameras, video cameras, scanners, video projection units, and microscopes available for the classrooms. With all of this state of the art technology available, hands-on learning and the development of thinking and problem solving skills are encouraged. The most important key to success in this project, though, is on going staff development to create the vision of seamless technology integration. My position is provided by the grant to provide this staff development and to assist the teachers in planning and integrating the technology correctly into the curriculum and their classrooms. By being available to the teachers daily I can create a supportive safety net for teachers and create the staff development as the staff is ready for the next step in technology integration. During the first year of the grant I have taken a lead role in the classroom in developing the vision and modeling instruction that integrates technology. During the second year my role will be a team teacher for the classes and in the third year I will be a consultant while still providing staff development and support.

The Metiri Group, a technology policy, research and consulting firm, from Santa Monica, CA, is evaluating the grant. The major focus of the evaluation will be to establish a correlation between the project activities and student learning in the primary grades. It will also measure the impact of the project on educators' vision for the role of technology within the curriculum, advances in teacher proficiency using teaching strategies involving technology, and changes in the learning environment.

We have had a very successful first year. At first it was difficult for the teachers to integrate the technology into their lessons. The teachers were receptive to the technology but they considered it something "extra" to "add" to their day. They did not use the laptops unless I was in the room to lead the lesson. They soon became more comfortable with the technology available in their rooms and realized it could enhance their lessons and provide valuable resources. This happened quickly because the students learned rapidly. It took these first and second graders little time to learn to use the tap and scroll features of a track pad, to access programs and the Internet, and to save work to a folder on the server. They took immediate ownership of the laptops, showing pride, enthusiasm and great care in their use of them.

The teachers began to take ownership by planning lessons that integrated the technology. They learned to look at their curriculum and objectives and plan ways technology could enhance and extend a lesson in ways that would not be possible without technology. By the end of the school year you could walk by at almost anytime and see the laptops being used in small groups, centers, or whole group lessons as comfortably as pencil and paper. The teachers did more in-depth projects involving research skills, collaboration, and higher-level thinking. Webquests, which are activities in which information that learners interact with comes from resources on the Internet and encourages critical thinking, cooperative learning, authentic assessment, and technology integration, were often used. Students were no longer being sent to the lab or a single classroom computer to play a game or "do" a program. The learning became authentic with specific tasks tied to the curriculum and its standards.

When we began this project our objectives were to enhance reading comprehension and writing. At the end of the year we saw student growth in what are called 21st Century Skills:

—Collaboration
—Research skills (Accessing, Processing and Communicating Information)
—Technology skills
—Student self-direction
—Paraphrasing at high levels

These will now become a focus for the grant and its evaluation. We also saw an enthusiasm for learning. The students remained on task for longer periods of time when using the laptops. When the students were engaged in accessing information with their laptops their reading levels were higher. We also saw the students working together to solve problems. At first, working in pairs resulted in one student dominating the learning and in arguments. By the end of the year we saw collaboration and problem solving with each pair or group.

We contribute the success of the program to an enthusiastic team that works together and we believe this is a necessary element of successful technology use in the schools:

—Teachers connect technology, instructional strategies, and content to student growth.

—The technology strategist partners with classroom teachers in identifying resources, planning, teaching and evaluation of lessons, projects, and activities.

—The administration provides leadership and support for the project, monitors progress, makes suggestions and recommendations, and keeps the project objectives on track.

—The technology coordinator maintains the infrastructure and hardware/software performance.

—The Area Education Agency Consultants assist in staff development planning and implementation and act in a consulting capacity.

—The parents provide support for the grant goals and objectives by having a high degree of involvement.

This project would not have been successful, or even possible without the funding of the federal government and the Waitt Family Foundation.

The main obstacle we encounter is time. Teachers have so many demands on them and are expected to do more each year in the same amount of time. It is hard to find time to plan and create lessons and implement them fully. We are also faced with finding the time and resources for our teachers in our rural area to attend professional conferences and staff development opportunities or to visit innovative sites that integrate technology effectively. Even though the teachers feel they are doing a good job of using the technology correctly they know they are not doing it as seamlessly as possible. They still feel they are "giving up" some necessary teaching to incorporate the technology. This seamless integration will become easier with use, but the teachers also need to be able to increase their knowledge base by attending conferences and workshops and by visiting other innovative classrooms.

Another obstacle we will face will be at the end of our three-year grant. We will have students who have had the opportunity of having state of the art technology readily available in their classrooms. When they enter 5th grade in 2003 they will not have laptops in their classrooms. They will need to go to the computer lab. During this first year of the grant we have found that computer labs are not nearly as conducive to technology integration. The teachers involved in the grant have realized it is much easier and more successful to integrate the technology when it is available at all times in their classrooms. Computers in the classroom are accessible when students and teachers need them (you can not always schedule a lab when it is needed), they become part of the learning environment, they allow flexibility, you can take advantage of teachable moments, and they are easy to monitor by teachers. By the end of the school year I saw a large gap in technology skills between the students involved in the grant who had access to computers at all times and those students not in the grant who had to use the lab. We need to continue to provide technology in the classrooms, as well as staff development and leadership in technology integration. It would be worthwhile to provide this technology in all of our classrooms and then track these first graders throughout their education to see the difference it has made in learning.

At the end of our three years we will also be faced with replacing or updating obsolete laptops and upgrading software. With declining enrollments, cuts in state funding (we lost approximately $30,000 in technology funds for 2001–2002), and looming budget cuts, it will be hard to maintain this worthwhile project. We will have collected data for the use of technology in primary classrooms but we need to maintain the use in these classrooms by keeping the technology current. Grants are great but what happens when they run out and the districts cannot afford to continue the project?

From our successes and from our obstacles I offer the following suggestions for the federal government:

—Assume a leadership role in providing the vision of what effective, seamless integration of technology should be in the schools. Stress the importance of teaching 21st Century skills in conjunction with the basic learning needed in schools.

—Continue to fund innovative projects, with funding being provided not only for the equipment but also for personnel and staff development to assure the success of the project. Then continue to fund those projects, if successful, so that schools are not forced to discontinue them for lack of money.
—Establish pilot sites throughout the country that effectively and seamlessly integrate technology.
—Provide beginning teachers entering the field with pre-service opportunities in technology integration.
—Continue to fund the e-rate, which provides discounts for Internet and phone services and frees up money that can be used for technology in other ways.

In conclusion, I want to share our future plans for the grant. We will continue to work towards seamless integration of technology, publish teachers' projects and student work on the Internet, equalize the access of students who do not have computers at home, stay on the cutting edge of instructional technology, and share our work and assist other schools in technology integration. We hope the federal government continues to provide the vision, leadership and funding in educational technology so that all schools can provide equal access to technology and that they learn to use the technology correctly as a tool to enhance learning.

Senator HARKIN. Thank you, Ms. Maxwell. Now we will turn to Cheryl Williams, president of The International Society for Technology in Education. Ms. Williams.

STATEMENT OF CHERYL WILLIAMS, PRESIDENT, INTERNATIONAL SOCIETY FOR TECHNOLOGY IN EDUCATION (ISTE)

Ms. WILLIAMS. Thank you, Mr. Chairman, for the opportunity to address you today to share my thoughts about the importance of strong Federal leadership in support of education.

Senator HARKIN. Cheryl, would you pull in that mike and just speak right into it?

Ms. WILLIAMS. OK, my teacher voice was not working. Is that better?

Senator HARKIN. That is good.

Ms. WILLIAMS. I am currently president of the International Society for Technology and Education or ISTE. I am also vice-president for Education at the Corporation for Public Broadcasting.

For 25 years I have been involved in education; the last 15 of which were around issues surrounding education technology and school improvement. Most recently, as director of Education Technology Programs at the National School Boards Association, and as chairman of the Board of The Consortium for School Networking or COSN.

Today, however, I am testifying solely in my capacity as president of ISTE. ISTE and its affiliates represent a large and diverse membership that includes more than 75,000 teachers, technology coordinators, administrators and other education technology professionals.

Our mission is to promote appropriate uses of information technology to support and improve learning, teaching and administration in K–12 education and colleges of education.

Today I will highlight five issues that ISTE would like you to consider as you prepare to make appropriations for fiscal year 2002 and beyond.

First ISTE strongly supports full funding for the new Federal Education Technology Block Grant. Over the past several years, strong and sustained Federal investment in education technology has played a critical role in the deployment of hardware, software, Internet connections and technology training to schools and libraries nationwide.

Two programs that have been of great assistance are the Technology Literacy Challenge Fund and the Technology Innovation Challenge Grant. This Federal involvement has paid off. During this same time period student-to-computer ratios have improved from 12 to 1 in 1998 to 7 to 1 as of 2000. Under both versions of the House and Senate ESEA Reauthorization bills, a number of Federal education technology programs, including the Technology Literacy Challenge Fund and the Technology Innovation Challenge Grant, would be consolidated into a single block grant and authorized at $1 billion annually. It is ISTE's view that the education technology block grant programs in both versions of the ESEA retain the same goals as their predecessors. When this subcommittee considers appropriations for the new block grant, we urge you to continue Congress's critical commitment to 21st century learning and fully fund the Education Technology Block Grant.

Second, the Preparing Tomorrow's Teachers to use Technology Program or PT3 has been very successful in building models to help pre-service teachers learn to incorporate technology into education and should be authorized and fully funded. ISTE believes that it is vital that the new generation of educators receive ample pre-service training in the basics of technology operation and curricula integration before they enter the classroom. The PT3 Program provides competitive partnership grants to promote collaborations among pre-service teachers, higher education and real world classrooms.

In 1999 ISTE, in collaboration with education groups and others, was awarded PT3 funds to develop a series of education technology standards for students, teachers, and school administrators known as The National Education Technology Standards Project or NETS. For both students and teachers, the NETS project provides guidance on the technology skills that each should have acquired at various points in their education and professional development. At least 26 States already have adopted these standards.

The final component of the NETS project, Technology Standards for School Administrators, will be released this fall.

ISTE fervently hopes that the final ESEA package will contain a separate authorization for PT3. We strongly urge this subcommittee to fully fund this program.

Third, the success in getting technology to the classroom means that we need increased funding for broader research on education technology. ISTE believes that OERI should be directed to pursue a new research agenda that will deepen educators' understanding of cognition and the impact of technology on the learning process.

Further, ISTE proposes the Federal Government establish an education technology clearinghouse for research and best practices.

Fourth, ISTE believes that three other education technology programs merit full funding. The Ready to Learn Program provides funding for research-based non-commercial education television programming and online resources for young children. Ready to Learn Program funds have helped launch such critically acclaimed programs as Sesame Workshops, Dragon Tales and WGBH in Boston's Between the Lions. Also the Star Schools Program has provided distance education opportunities to more than two million students in six thousand schools nationwide.

And finally, the Community Technology Centers Program assists low-income urban and rural communities to gain access to technology by providing grants to public housing facilities, community centers and libraries.

PREPARED STATEMENT

Fifth and last, the E-Rate Program has been extremely successful and should be maintained in its current structure. The E-Rate Program has already provided over $6 billion in discounts on telecommunications services, Internet access and internal connections to public and private schools and public libraries nationwide. The E-Rate has helped ensure that virtually every library and school building has at least one Internet connection and that 77 percent of all public school classrooms have Internet access. And it has done all this without receiving any Federal funds, relying instead on the Universal Service Fund. We request that your Subcommittee not include in your Bill any language that would adversely impact the E-Rate or its funding stream.

Thank you again for this opportunity to address you today. I am available to answer any questions you may have.

[The statement follows:]

PREPARED STATEMENT OF CHERYL WILLIAMS

Mr. Chairman and members of the Subcommittee, thank you for this opportunity to address you today to share my thoughts about the importance of federal support for education technology. My name is Cheryl Williams, and I am President of the International Society for Technology in Education—ISTE. I am also Vice-President for Education at the Corporation for Public Broadcasting. For twenty-five years, I have been involved with issues surrounding education technology and public school improvement. In my previous position as Director of Educational Technology Programs for the National School Boards Association, I collaborated with school district administrators and school board members to plan and implement education technology programs. Additionally, I oversaw numerous education technology-related publications and organized the annual Technology + Learning Conference, one of the largest annual education technology convenings in the country. While with NSBA, I also served as Chairman of the Board for the Consortium for School Networking (CoSN). In my current position with the Corporation for Public Broadcasting, I oversee the development and coordination of the Corporation's educational projects in conjunction with partners from across the learning community. Today, I am testifying solely in my capacity as President of ISTE.

One of the highlights of my career was my recent election as President of ISTE, the leading organization for education technology professionals. ISTE and its affiliates have a large and diverse membership that includes more than 75,000 teachers, technology coordinators, administrators, and other ed-tech professionals. Our mission is to promote appropriate uses of information technology to support and improve learning, teaching, and administration in K–12 education and colleges of education. In furtherance of this mission, we have placed ourselves at the forefront of the technology standards movement through our National Educational Technology Standards Project (NETS), which has developed a series of influential standards for student achievement, teacher skills, and the academic environment. We also provide research, evaluation, and consulting services to school districts, public agencies, private foundations, and universities. Finally, ISTE has been a strong advocate on Capitol Hill for the use of technology in teaching and learning because we believe that federal leadership in this area is crucial if students, educators, and administrators are to reap the full benefits of the Information Age.

Today, I will highlight five issues that ISTE would like you to consider as you prepare to make appropriations for fiscal year 2002 and beyond.

First, ISTE strongly supports full funding for the new federal educational technology block grant.—Over the past several years, strong and sustained federal investment in education technology has played a critical role in the deployment of hardware, software, Internet connections, and technology training to schools and libraries nationwide. In the past three years alone, Congress has appropriated nearly

$1.7 billion for the Technology Literacy Challenge Fund (TLCF) and the Technology Innovation Challenge Grant (TICG), two federal programs that support school district efforts to develop technology plans, acquire hardware and software, engage in teacher training, and create innovative technology applications. And this federal involvement has paid-off: during this same time period, student to computer ratios have improved from 12 to 1 in 1998 to 7 to 1 as of 2000. Teacher access to professional development on technology has also improved: as of 1999, over 90 percent of all teachers have access to some technology-related professional development.

Beyond mere statistics, though, these programs have had a profound affect on the school districts that have been fortunate enough to receive grants:

—In Phoenix, Arizona, a grant from the Technology Innovation Challenge Grant (TICG) program funded an "Assessment server"—an online resource that allows teachers to construct customized tests to provide students immediate feedback. This classic "drill and practice" application turned out to be particularly useful in teaching ESL students, who oftentimes are afraid to participate in class and thus may not receive the special attention that they need. Because of this program, these students are now receiving consistent feedback and many are now earning passing grades for the first time.

—Funds from a TICG grant have also launched Project Gen Y in Olympia, Washington, an innovative professional development project that allows students and teachers to collaborate on developing a technology-enriched lesson plan. Through Project Gen Y, mentor teachers work with students to develop technology, communication, and project management skills, and students then work with one of their regular teachers to develop a lesson plan. Students in grades 3–12, working for a semester or a year, have completed more than 3,000 projects, spanning all subject areas. In this student-centered model, students gain advanced skills in leadership, communication, and critical thinking, as well a deep familiarity with the subject content, while their teachers learn technical skills and new teaching methods.

—In New York, a Technology Literacy Challenge Fund (TLCF) grant funded Project Accelerate, which put New York's state educational standards online in a form accessible to teachers, and tied them to a series of online courses aimed at preparing teachers to use these standards. The online courses include streaming video and interactive modes, and are linked to curriculum and lesson plans. New features include web authoring tools, student tutorials, and survey instruments, with more are being added all the time. Through Project Accelerate, teachers, administrators, students and parents, from public schools and private schools, can interact with one another, and improve the learning experience for everyone.

—In northern Pennsylvania, the Jersey Shore Area School District used TLCF funds to increase parental involvement and tailor curriculum to individual students. Parents can check their children's progress on the Internet, using a secure online grade book, starting with the 2001–2002 school year. Parents also have ready access to the teachers via email, voicemail, and a special Homework Hotline.

—One of the most innovative school computing implementations in the country came from state funding to the Lemon Grove School District in California. In this district with a high number of ESL and at-risk students, technology has freed teachers to teach and students to learn—and student standardized test scores in math and reading have risen significantly as a result. Many of the biggest gains have come from students who originally had some of the lowest test scores. Lemon Grove's success has come from involving parents, teachers, and students. Extensive staff development has prepared teachers to use the technology, developing web-based instruction and building research sites for students. Parents can access lessons, assignments, and school news, through inexpensive server-based thin-clients that work on a wide variety of devices—computers, hand-held devices, and others. And students—with greater access to technology, and a trained teaching staff—are using technology to learn. In Lemon Grove, even first graders are creating PowerPoint presentations and giving them to other children.

Under both versions of the House and Senate Elementary and Secondary Education Act (ESEA) reauthorization bills that the House-Senate Conference Committee is considering currently, a number of federal education technology programs, including the TLCF and the TICG, would be consolidated into a single block grant and authorized at $1 billion annually. It is ISTE's view that the education technology block grant programs in both the House and Senate versions retain the same goals as their predecessor programs: equipping our nation's schools with advanced technology and affording them opportunities to develop innovative technology strate-

gies and programs to improve teaching and learning. We have come a long way in the past decade but the task is far from complete. Current teachers continue to have insufficient familiarity and comfort with using technology in the classroom and limited ability to integrate Internet resources into the curriculum. Most teachers with more than 10 years' experience received little or no college preparation to effectively utilize technology in the classroom. When this Subcommittee considers appropriations for this new block grant, we urge you to continue Congress' critical commitment to 21st century learning and fully fund the education technology block grant.

Second, the Preparing Tomorrow's Teachers to use Technology program—PT3—has been very successful in building models to help pre-service teachers learn to incorporate technology into education, and should be authorized and fully funded.—Even with the great strides that schools and libraries have made in acquiring adequate hardware and software and connecting to the Internet, the full benefit of education technology cannot be realized if teachers are not trained to use technology and to integrate it into their daily classroom activities. A 1999 survey by the U.S. Department of Education's National Center for Education Statistics showed that nearly two-thirds of all teachers felt that they were not prepared or only somewhat prepared to use technology in their teaching. With 2.2 million teachers expected to be hired over the next decade to fill new positions and replace retiring teachers, ISTE believes that it is vital that this new generation of educators receive ample pre-service training in the basics of technology operation and curricular integration before they enter their classrooms.

The federal government has already demonstrated that it recognizes this need through its dedication of substantial resources to the Preparing Tomorrow's Teachers to Use Technology (PT3) program. Established as an unauthorized program in 1999 and funded at $275 million over the past three fiscal years, the PT3 program provides competitive grants to partnerships of school districts, colleges of education, states, industry and others to support innovative programs that promote collaboration among pre-service teachers, higher education, and real-world classrooms. The program is focused on problems identified by research, guided by comprehensive evaluation, and devoted to developing scalable models of effective uses of technology to teach.

ISTE, as a recipient of a PT3 grant, knows first-hand the value of this federal investment. In 1999, ISTE in collaboration with education groups, curriculum organizations, government entities, foundations, and corporations, was awarded PT3 funds to develop a series of education technology standards for students, teachers, and school administrators, known as the National Education Technology Standards project (NETS). For students, the NETS project created profiles of technology-literate students at key developmental points—e.g. grades PreK–2, grades 3–5—that describe the technology competence that students should exhibit at the completion of each grade. Similarly, the NETS standards for teachers include standards for pre-service teacher education, which provide guidance on the skills that they should have acquired at various points in their education. For instance, upon completion of the general preparation component of their program, pre-service teachers should be able to use content-specific tools to support learning and research, and use productivity tools for collaborative work. At least 23 states already have adopted these standards and numerous universities use these standards in their accrediting processes. The final component of the NETS project, technology standards for school administrators, will be released this fall. Although still a work in progress, the new NETS standards will guide administrators in overseeing and implementing education technology: developing a technology plan, basing decisions on sound data, and confronting the social and ethical implications of technology applications.

More typically, though, PT3 grant recipients are consortia of local school districts and colleges of education that use these funds to develop model pre-service professional development programs. The University of Northern Iowa, for example, received a PT3 grant to video-document classroom teachers, and allow pre-service teachers to study, via streaming video, the classroom teachers in action. The pre-service teachers then evaluate their own ability to use technology in the classroom using the NETS standards as a benchmark. Another example comes from Mississippi, where a PT3 grant funded Project T-n-T, which is designed to foster the relationships between pre-service teachers at Mississippi State University and rural public schools. Project T-n-T encourages pre-service teachers and supervising teachers to collaborate on effective uses of technology in the classroom and produce video simulations and online teacher handbooks on best practices. Finally, each year in rural northwestern Pennsylvania, a PT3 grant to the ADEPTT Consortium of three public universities allows more than 1,500 pre-service teachers gain competencies in video conferencing, databases, and the use of the Internet in teaching.

Since its birth in 1999, PT3 has been operated by the U.S. Department of Education as an unauthorized program and has been generously supported by Congress during the appropriations process. During this year's ESEA reauthorization debate, the Senate adopted in Committee an amendment offered by Senators Jeff Bingaman and Pat Roberts that would separately authorize the program for 6 years with an authorization level of $150 million. ISTE fervently hopes that the final ESEA package that emerges from the House-Senate Conference will contain this separate authorization. We also strongly urge this Subcommittee, when it sets its fiscal year 2002 appropriations level, to take into account the pressing need for PT3 as well as the impressive record of achievement it has built in its short history, and fully fund this program.

Third, the success in getting technology to the classroom means that we need increased funding for broader research on education technology.—Since education is ordinarily not a for-profit enterprise, the federal government must take upon itself the responsibility for the majority of education research. The federal government has tasked the Office of Education Research and Improvement (OERI) with the responsibility of conducting in-depth studies of classroom resources and education improvement programs. Last year, OERI received an appropriation of $382.1 million to run its network of research institutes and regional education laboratories, operate the National Center for Education Statistics, prepare and administer the National Assessment of Education Progress survey, and disseminate research via the National Library of Education and the Education Resources Information Clearinghouse.

With OERI expected to be reauthorized this year, ISTE is compelled to seize on this opportunity to acknowledge the important contributions to education research that OERI's regional laboratories and research institutes have made, and to advocate for continued federal support for it through the appropriations process. During the coming reauthorization process, ISTE also intends to lobby for Congress to mandate that OERI pursue a new research agenda that will deepen educators' understanding of cognition and the impact of technology on the learning process, and further their ability to develop and evaluate new education practices. Further, ISTE will propose that the federal government establish an education technology clearinghouse for research and best practices, so that local and state-level educators have access to the latest research and most effective instructional models.

A strong research agenda is key to fully exploiting the potential of technology to transform education. Therefore, ISTE supports funding specific research and dissemination of results and best practices.

Fourth, the Ready to Learn, Star Schools and Community Technology Centers programs represent excellent and varied uses of technology to deliver education and deserve continued support.—ISTE would be remiss if it not pay tribute to three other programs that foster the use of technology in teaching and learning, that we believe deserve to be reauthorized separately, and that merit full funding: the Ready to Learn program, the Star Schools program, and the Community Technology Centers program. The Ready to Learn program, which received appropriations of $16 million in each of the last two fiscal years, represents Congress' continuing investment in the development of research based, non-commercial, education television programming and online resources for young children. Ready to Learn program funds have helped launch such critically acclaimed programs as Sesame Workshop's *Dragon Tales* and WGBH in Boston's *Between the Lions*, as well as aided PBS's efforts to create a series of high-quality interactive online resources for kids, and materials for adults to use to supplement PBS broadcast programming. The Star Schools program, which has provided distance education opportunities to more than 2 million students in 6,000 schools nationwide, funds the use of satellites, cable, and the Internet to provide normally inaccessible education content to small rural and urban schools. For the current fiscal year, Congress appropriated $59 million for this program and we believe that it should be fully funded in fiscal year 2002. Finally, the Community Technology Centers program assists low-income urban and rural communities to gain access to technology by providing grants to public housing facilities, community centers and libraries. Despite its considerable success, efforts have been made to either eliminate it or transport it from the U.S. Department of Education to the Department of Housing and Urban Development. We applaud the efforts of Senator Barbara Mikulski to separately authorize this program and expand its funding. ISTE believes that these three programs are time-tested and worthy of continued federal support.

Fifth and last, the E-Rate program has been extremely successful and should be maintained in its current structure.—By virtually any objective measure, the E-Rate is a success story. During its first three years of existence, the E-Rate program has provided over $6 billion in discounts on telecommunications services, Internet ac-

cess, and internal connections to public and private schools and public libraries nationwide. The FCC has estimated that the program has leveraged an additional $4 billion for infrastructure investments from state and local governments. In each of the program's first three years demand for its discounts has steadily increased, with $5.2 billion in discount requests for Year 4 alone. The E-Rate has helped ensure that virtually every library and school building has at least one Internet connection, and that 77 percent of all public school classrooms have Internet access. And it has done all of this without receiving any federal funds, relying instead on the universal service fund.

Over the past six months, the Administration has advocated that the program's list of services eligible for support be expanded to include software and professional development, even though the program is already oversubscribed for services that are currently eligible. Additionally, the Administration suggested that the program be consolidated with other federal education technology programs, thus turning it into a formula grant program. Since ISTE is convinced that the key to this program's success lies in its stable funding stream, we adamantly oppose any such destabilizing changes. We request that this Subcommittee follow the lead of the House Appropriations Committee in its Commerce Justice State Appropriations bill and not include in your bill any language that would adversely impact the E-Rate.

Thank you for this opportunity to address you today. I am available to answer any questions of the Committee.

Senator HARKIN. Thank you very much, Ms. Williams. Now we turn to Thomas Gann, Director of Strategic Alliances for Global Education Research of Sun Microsystems, Incorporated. Mr. Gann.

STATEMENT OF THOMAS GANN, DIRECTOR, STRATEGIC ALLIANCES FOR GLOBAL EDUCATION RESEARCH, SUN MICROSYSTEMS, INCORPORATED

Mr. GANN. Thank you, Mr. Chairman, for holding this hearing. I appreciate your leadership on human resources and education issues, and I also appreciate the interest of the Committee in general.

Today, Sun Microsystems is a $20 billion global company focused on providing network solutions in the area of hardware and software.

We have come a long way since 1982 when we were founded by four graduate students, two from Berkeley and two from Stanford. In those days we were making high-performance desktop computers for the education and research markets. Our computers from day one came optimized for the Internet and, in fact, education has been at the core of everything we have been doing since then.

Today, Sun is fully committed to the K–12 market. In particular, we want to ensure that this country's future workers, our kids, get the best possible training moving forward. You know the key is that the information technology industry depends on human capital. So investing in human capital is profoundly in the national interest and certainly in the interest of information technology industries.

Today, I am here to discuss what is working and what can be done better to meet the information technology needs of our schools, teachers, and students. Today, the United States has made significant headway in bringing access to computer technology to schools throughout the nation. According to NetDay, 8 out of 10 teachers think that information technology is helping students do a better job of learning. This is the good news.

The bad news is that the current model of educational computing putting traditional computers in every classroom or on every desk-

top can also impose significant drains on resources in terms of cost, maintenance, and teaching time.

For example, the same NetDay survey found that two out of three teachers believe that the Internet is not very well integrated into their classrooms. By not taking full advantage of the Internet or web-based learning, schools can get bogged down with expensive hardware, software, continual upgrades, expensive technical support and a constant need for teacher retraining. These are expenses that even rich schools have trouble keeping up with.

In private business, for example, one computer professional is responsible for servicing 50 to 100 computers. In schools, each professional is responsible for servicing between 700 to 1,000 computers. This is an impossible task and it forces too many teachers to spend too much valuable time sorting out computer problems when they should be spending their time teaching.

While personal computers have and will continue to have an important role to play, we believe that a good deal more attention should be placed on building long-term, reliable back-end architectures focusing on the benefits of centralized technology and networking of the district's computing systems. This, in fact, will facilitate a good deal of communication and collaboration among parents, teachers and students. The private sector is already doing this, that is, moving to this model and the results have been very good in terms of improved productivity. This anytime/anywhere computing model relies upon open systems architecture in which information is accessed and delivered via the Internet. Any number of devices, PC's, inexpensive network terminals and even cell phones, can access this system and it all works very well because it is based on the open standards of the Internet.

The other advantage of this system is that technology maintenance can be handled at the backend at the school district level. This further allows teachers to get out of the business of worrying about technology and back into the business of worrying about teaching.

The other good news, like in business, entire IT departments now can be managed outside of the school by telecom firms or other service providers; thus, further allowing schools to focus in on their core competencies.

Now we believe the Federal Government really does have a significant and powerful role to play in making incentives that help Internet resources be widely and effectively deployed in schools.

First, the Federal Government should partner with the States' school districts and the private sector to develop a clearinghouse of best IT practices. Thus, schools anywhere around the country can get the benefit of learning from other school districts.

Second, all levels of government currently spend 2 percent of their education dollars on technology. We think that number should be doubled, something closer to about 5 percent.

Third, Sun strongly supports a recommendation made by The Computer Communications Industry Association to create a system of national digital school districts. These projects would be largely modeled on similar projects that have worked quite well in California and also Pennsylvania. These demonstration projects would provide funding for the implementation of smart computing archi-

tectures in selected schools around the country. Best practices learned from these demonstration projects could then be used to improve the performance of information technology throughout all of our schools in our nation.

PREPARED STATEMENT

Fourth, we urge all levels of government to support policies that promote the use and implementation of open architecture technologies in schools. This will ensure that schools do not get locked into using any one technology made by any particular company. This will ensure further that schools have as many technology options as possible moving forward, and in fact, in the private sector, we see the trend towards open systems really growing and it is working well and it is very inexpensive.

In conclusion, I would like to thank the committee for giving me a chance to spend time talking about these very important issues and I look forward to answering any questions that I might be able to help on. Again, thank you.

[The statement follows:]

PREPARED STATEMENT OF THOMAS GANN

Sun Microsystems, Inc., would like to thank the Subcommittee on Labor, Health and Human Services, and Education as well as the 107th Congress for its commitment to improving America's K–12 education system. As Congress moves to finalize the Elementary and Secondary Education Act in Conference Committee, it is clear that the opportunity to achieve significant progress toward improving our country's educational system is now a reality. As focus shifts to the appropriations process, the work of this committee will become pivotal to the long-term success of the Education Act and to the realization of meaningful education reform.

Sun believes that technology can and should play a bigger role in the education of America's children, and has endorsed the report of the bi-partisan congressional Web-based Education Commission. To that end, I am here today to discuss what is working, and what can be done to better meet the information technology needs of our schools, teachers and students.

THE NEED FOR NETWORKING

Through numerous public and private initiatives, the United States has made significant headway in bringing access to computing technology to schools throughout the nation. Schools are rapidly being equipped and wired, with nationwide statistics showing tremendous results.

According to a NetDay survey released in March 2001, 97 percent of teachers surveyed said they had Internet access in their schools and 80 percent had connections in classrooms. Eight out of ten teachers also believe that computers and access to the Internet improve the quality of education.

This is the good news. Our nation has embraced the idea that computers and information technology can advance the learning environment for our children. The bad news is that the current model of educational computing—putting a computer in every classroom, or even on every desk—can also impose a significant drain on resources in terms of cost, maintenance and teaching time. In addition, without quality web-based educational content, classroom computing all too often becomes an exercise in underachievement and can actually exacerbate the digital divide.

For example, the same NetDay survey found that two-thirds of teachers agree that the Internet is not well integrated into their classrooms and only 26 percent of them feel pressure to use it in learning activities.

For the most part, current public and private initiatives have concentrated on providing computer hardware to classrooms. Not only is this insufficient for fully capitalizing on web-based learning opportunities, it can become a significant drain on available resources -rife with hidden costs.

The GartnerGroup reports that only 17 percent of the cost of a personal computer is in the purchase price, with the rest in hidden maintenance, required upgrades, etc.

Moreover, according to Market Data Retrieval (MDR), 69 percent of school instructional technology budget allocations are being spent on hardware, followed by 17 percent on software, and 14 percent on staff development. Clearly, these are important and necessary categories for investment—yet the numbers tell a story about hidden technology costs. By not taking full advantage of the Internet, schools get bogged down with expensive hardware and software, continual upgrades, expensive technical support, and a constant need for teacher re-training. These are expenses that even the most affluent school districts likely have trouble meeting. To expect less affluent districts—often found in rural areas and the inner cities—to keep pace is usually not an option, further contributing to the growth of the digital divide.

For classrooms to realize the benefits of a web-based education environment—one in which the technology adapts to the needs of the user, instead of the user adapting to the constraints of the technology—we must rethink the current computer in the classroom model, and start thinking about the network architecture that could be employed by an entire school or school district. A single PC on a classroom desk doesn't cut it. On the other hand, a computing terminal on a desk, networked to other classrooms and schools throughout a school district and beyond can provide a breathtaking array of educational possibilities—in addition to significant long-term cost savings.

While personal computers have, and will continue to have, an important role to play, we believe that less emphasis should be placed on purchasing this year's model of PC, replacing dated components, and upgrading software—with more emphasis placed on building long-term, reliable backend architecture. This means focusing on the benefits of centralized technology and networking a district's computers by building systems with scalable servers.

A network-computing model for education envisions a system in which teachers, administrators, students and communities will all have tools to enable access to information, web learning, peers, parent-teacher communities, and greater learning opportunities—anytime, anyplace, by anyone, on any device. This anytime/anywhere computing model relies upon an open systems architecture in which information is accessed and delivered via the Internet.

For example, by building a network framework within schools and school districts—based on open standards—lesson plans and web-based instructional content can be seamlessly integrated, for classroom and at-home access. Other advantages include real-time reporting of student achievement, which can allow students, parents and administrators to better track classroom progress, and maximizing efficiency in routine administrative tasks, such as scheduling and grading.

Using an open systems model, reliable, manageable and secure web-access is available to every user. This model offers not only accessibility, but distinct economic advantages in the form of reduced costs and increased access for students. This should be of vital importance to educational institutions.

Allowing for "self paced" learning can help keep students more engaged and ultimately, make classroom time more productive for teachers and students. As average class size grows, student populations become more diverse. This, coupled with the trend towards "mainstreaming" students with special needs, places added pressure on teachers to give critical one-on-one time. E-Learning can augment individualized teacher instruction to the benefit of both teacher and student. In addition, a "smart" e-learning program, can adapt itself to respond to an individual students needs by automatically identifying areas where mistakes are being made, and directing the lesson in a manner that specifically addresses problem areas. Lower cost web devices and the elimination of the need for special software on the device itself will allow for more students to have direct access from home or public facilities like libraries, to the Internet and specifically designed educational content.

Administrators and teachers also appreciate the ability to collaborate with colleagues, sharing information, lesson plans and projects, as well as strengthening ties with parents. A networked system is the only efficient method for achieving a truly collaborative e-learning environment.

PROGRESS IN E-LEARNING

Industry efforts and public/private partnerships have accounted for significant progress in providing access to computing technologies within schools. One example of particular relevance is the SchoolTone Alliance, an organization of leading education technology and service providers that includes AOL-Time Warner, Bigchalk.com, BritannicaSchool.com, Lucent Technologies, and Sun Microsystems. Collectively, they create web-based portal solutions for content, communications tools, applications and professional development for the education community. These

education portals are web sites that provide organized access to the Internet and the delivery of services specifically tailored to the needs of the education community.

The need for services such as SchoolTone have become abundantly clear. As we have learned, providing schools with personal computers and Internet access is not enough, as educators often feel overwhelmed -unable to fully utilize the tools they already have.

SchoolTone Alliance members believe that by building a portal computing infrastructure and outsourcing a school's IT needs to service providers, schools and school districts can expedite the deployment of technology while reducing the overall costs.

We believe the prospects offered by industry alliances such as SchoolTone will be the roadmap to the future of education on the Internet, and will become the preferred method for closing the digital divide among schools and students across America.

With computing becoming a "utility" (similar to dialing a telephone) and new educational portals delivering quality content over the web, the economics for the education community can change. A high maintenance, fixed cost, depreciating infrastructure can become a maintenance-free, variable cost and easy to use environment . . . one that levels the playing field for education, and enables educators and students to focus purely on educational matters.

In private business, it is estimated that a professional technician is responsible for servicing 50–100 computers. In our schools, each technician, on average, is responsible for 700–1,000 computers. Clearly, this is an impossible task, forcing teachers to spend class time doubling as PC technicians, or worse, meaning substantial downtime for classroom computers.

The Web-based Commission has also called for stepped-up "training and support for educators and administrators at all levels," and the National Education Association recommends that schools devote 40 percent of their technology budgets (up from an average of 17 percent) to teacher training. Moreover, the National Center for Education Statistics found that teachers cited a lack of time to learn, practice, or plan methods for incorporating technology in the classroom as the greatest barrier to their use of computers and the Internet.

While training is vitally important, and investments in professional development for teachers is critical, we believe that one of the most compelling points in favor of the network-centric education model is that teachers would no longer be required to double as IT professionals. Technology maintenance would be handled at the backend, at the school district level, allowing teachers to focus on how they wish to use the tools at their disposal.

As Web-based education evolves, teachers will be able to free themselves to teach and students to concentrate on learning, without the need for sophisticated computer skills to take advantage of the web.

THE FEDERAL ROLE

Sun believes Federal leadership is the catalyst needed to put all of our nation's schools in a position to make Internet technology work for them—and fully realize the promise of web-based opportunities in education.

We believe that the Federal Government can and should play a significant role in creating incentives to make Internet resources—especially broadband access and backend infrastructure—widely available, and to encourage the development of web-based content specifically designed for use in education.

The goal of providing the best in technology to America's schools cannot be measured simply by access to technology and web-based educational content. The measure of success must be measured by student achievement.

Recognizing that knowledge management of best practices in the implementation of education technology does not transcend beyond state boundaries, to help steer school districts towards the most effective use of resources and educational techniques, Sun supports the formation of a national center of excellence to report on best practices.

Too often, technology is implemented without a strategic vision. The Federal Government, in partnership with state boards of education and the information technology industry, should become a clearinghouse—helping states and school districts to avoid duplicating efforts and wasting resources.

The economic benefits of anytime/anywhere computing are as clear for cash-strapped school districts as they are for private industry. Making the most of our educational resources is the key to building the skilled domestic workforce necessary to ensure America's economic future.

While progress towards achieving full connectivity will continue, and no doubt will be achieved, without concurrent development of meaningful web-based content, we would not be making the most of a resource with unlimited educational potential. To truly make headway in closing the digital divide, we must recognize that connectivity is not the ultimate goal, but rather, a method for enabling access to meaningful web-based educational content.

For the educational community, connecting schools to the Internet and to each other will provide benefits in to three key areas:

1. *Lower Costs*.—District-wide networks will create economies of scale, with schools sharing costs for backend technology and ongoing maintenance. This translates into lower IT expenditures for individual schools, and less need for teachers to be trained as IT specialists.

2. *Quality Content*.—Developing web-based content will keep educational resources current. Updating a text book can take years, while updating a web site takes minutes.

3. *Easy Access*.—With access to the Internet, any student, anywhere can take advantage of the best web-based educational resources. This concept has tremendous implications both for distance learning in rural areas, and for raising the level of academic achievement in our nation's poorer, urban schools.

RECOMMENDATIONS

Funding.—Currently two-percent of all public education dollars—Federal, State, and local—are committed for technology. Sun supports an increase in funding to five-percent. With the right investments today, to support teachers' professional development, access by schools to the latest in broadband technology, and the installation of district-wide smart network architecture, we will all reap the benefits of a leaner, stronger educational system, and a better trained, better prepared workforce for our future. Harnessing the potential of an Internet-based education model in this way will lead to significant cost savings for schools, increased access to quality content, and greater productivity.

Digital School Districts.—Sun supports the Computer and Communications Industry Association call for a national digital school district initiative. This model program would provide funding for implementation of a smart network computing architecture in selected school districts throughout the country. A two-year Federal allocation of $52,000,000, to be met through an equal commitment by each participating state, would provide a big step toward implementing the vision of the Web-based Commission. Digital school funding would be in three phases:

—*Phase 1*.—Create a National Digital School District Initiative as part of the reauthorization of the Elementary and Secondary Education Act. Fifty-one school districts would be funded, one in each state and the District of Columbia, based upon a competitive grant process. The program would be authorized at $26,000,000 for Phase 1.

—*Phase 2*.—A second round of funding, at $26,000,000, would create 51 additional Digital School Districts; with states and the District of Columbia providing matching funds.

—The total Federal commitment would be $52,000,000—with the benefit of model school districts in every state serving as resources and demonstration centers. These schools would form the nucleus of a national center of excellence to report on best practices by providing tangible examples of how technology can improve education, achieve cost savings, and deliver education in ways currently not imagined.

Funding at this level—with a concurrent commitment for in-kind support by private industry—would be sufficient to equip public schools with the necessary technology, as well as providing adequate seed money to encourage the development of meaningful web-based educational content. The following are two examples of model programs that should be commended for concentrating resources on technology.

"A model charter school in Napa, California is part of an effort to start ten new High Tech High Schools throughout California, each participating school receives a one time matching grant of $2,000,000 for start-up expenses, with private sector companies making significant donations of equipment, software and services."

"Pennsylvania's Digital School Districts Initiative seeks to revolutionize education through the use of technology. From proposals submitted by schools throughout Pennsylvania, three districts were selected to serve as pilot programs—each receiving up to $2,000,000 in state funding, with private companies contributing products and services."

Both of these programs have taken the first step, and the lessons they have learned can form the basis for the broader strategic initiative to implement the smart network architecture in school districts throughout the country.

A national network of model schools such as these, located in urban and rural areas throughout the nation, would become fully functional centerpieces for web-based learning—allowing area educators to become acquainted with the concepts and practical applications of e-learning.

With this modest financial commitment, the Federal Government could become the catalyst for the growth of web-based education—a model for true educational reform.

Open Standards.—Sun urges public officials at every level to support policies that promote the development of infrastructure and content based on open standards. Open standards are needed to make web-based computing a reality. We need a policy that enforces and rewards the use of Internet standards such as browser-based applications, IMS, SIF, HTML, XML, JAVA and JINI and other standards developed by mutual agreement through standards bodies. The use of open standards will ensure the broadest participation, greatest innovation, and lowest costs by providing a technologically level playing field for all.

CONCLUSION

Because schools lack the resources to invest in web-based learning technologies on their own, the government should adopt policies that encourage investment in backend infrastructure and content—as well as changing the metric used to judge success. Access to a personal computer and the Internet alone are not enough. The metric to measure success must shift to the ability to access web-based learning systems—including meaningful digital content.

Without widespread access and use of dedicated education portals, the power of the Internet to reduce costs for schools, and facilitate access to the best educational content, will remain unfulfilled.

During recent years, America's hi-tech industries have faced a critical shortage of skilled workers. Indeed, we've had to appeal to Congress to increase the level of H1–B visas to allow greater numbers of highly skilled foreign workers to come to this country. Importing foreign workers, however, is not the solution that we should rely on in the future. We must develop a domestic workforce to meet the needs of an increasingly competitive global economy. We firmly believe that improving America's primary and secondary education is of the utmost importance if we are to develop the talent we need.

We have the resources today to make a difference. Working together, industry and government can provide the roadmap for schools throughout the country to make the investment in smart, efficient network computing -giving our children all the advantages they deserve.

Thank you, Mr. Chairman.

Senator HARKIN. Thank you very much, Mr. Gann, and I want to get back to talk to you about changing that concept of how we are doing this. I think it is very exciting.

Now, we will turn to Dr. Rose, co-executive director of CAST.

STATEMENT OF DR. DAVID H. ROSE, Ed.D., CO-EXECUTIVE DIRECTOR, CAST

Dr. ROSE. Mr. Chairman, thank you for having me here. It is indeed an honor to be here and particularly because members of this committee have been central in passing landmark legislation, ADA, IDEA, Section 508, that have been critical in assisting individuals with disabilities in the past.

In particular, students with disabilities now can assume a right to a free and appropriate public school education and can expect to find physically accessible educational buildings.

Tragically, however, and that is why I am here today, most of the curricula, the materials for learning in those classrooms, are not, in fact, available or accessible to students with disabilities. At this particular moment in history, when innovative new educational technologies are proliferating, we have a unique and urgent oppor-

tunity to right this injustice. I am here to argue that it is a moment of great opportunity to both save money in the long term and save students and particularly to benefit all students.

I want to describe three key areas in educational technology that are significant for students with disabilities: Assistive technology, digital curricula and universal design. In each area I want to offer a couple of recommendations. Assistive technologies are what most people think of when they think of what technology does for people with disabilities. Assistive technologies allow people to overcome barriers and there are visible examples on television all the time.

Matthew, a third-grader, with physical disabilities who cannot speak or use his arms or legs can use electronic switches to drive a wheelchair and operate the computer to write and communicate.

Katherine, a six-grader, who is blind, uses screen reader technologies to navigate the Internet and do her social studies homework.

Nina, who has a brain injury that causes her to be aphasic, uses an electronic augmentative device to speak to her friends and collaborate on schoolwork.

Even more spectacular, assistive technologies are under development including devices that can be implanted in the brain for hearing, for vision, for control of paralyzed muscles. These essential uses of technology for individuals with disabilities will require sustained Federal support. There is simply not enough profit in developing these low incidence technologies to attract investments of the private sector.

So I make two recommendations. Congress should continue to fund research and development under part D of IDEA to ensure that we get powerful new assistive and augmentative technologies.

And second, Congress should support through technical assistance grants contracts for the training of assistive technology specialists so that every school district knows about these technologies and knows how to use them. I spell out the recommendations in some more detail.

Second, though, I want to talk about digital curricula because these recommendations I have made about assistive technologies often are what people again imagine. And it is dangerous to view assistive technology as the sole or most important focus of educational technology for students with disabilities. Such an orientation places the emphasis on the individual with the disability as what is broken. We need, in fact, to concentrate on the curriculum as what is broken. The environment itself is often hostile to students with disabilities.

The lesson of ADA, in fact, that Senator Harkin has been an important part of, is that small affordances built into the environment, like curb cuts and ramps, are as critical for access as are the assistive technologies like motorized wheelchairs.

The same is true for educational materials and methods. We need to use the new technologies not only to overcome existing barriers, but also to design better learning environments with fewer barriers right from the start.

I want to give you an example. In The Concord, New Hampshire public schools that we have been working with for about 5 or 6 years, teachers and parents have been engaged in a painstaking ef-

fort to digitize every single piece of their curriculum. Why are they going to all this trouble? They are doing it because the digital versions of the books are much better for students with disabilities. The differences are not in the content; the digital versions have the same content. The difference is the flexibility with which that content can be displayed.

In print versions, the content is permanently fused to paper. It is fixed. Everybody gets exactly the same thing. In digital versions, the content is presented dynamically by the computer. As a result, content can be displayed in many different ways and adjusted to many different learners.

Let me just give some examples: Imagine in a classroom that we have worked with, all the students are reading, "To Kill a Mockingbird". In a digital version, Sarah, a student with low vision can display the text in a very large font so she can see it.

Bill, a student who is blind, can have the computer display the text as spoken words, or have the computer print it out easily on a Braille printer.

Jennifer, a student with severe physical disabilities, can change the display; turn its pages, with a single blink of her eye. Michael, a student with dyslexia, can click on a difficult word to have the computer read it aloud or link it instantly to a context-based definition.

In these ways, digital versions of traditional curricular materials can effectively reduce barriers to learning; thereby reducing the costs associated with expensive later adaptations and pullout programs.

We can actually do a lot more with digital curricula. In a recently completed study that we have done through the Department of Education's OSEP Program, we have digitized books and we have begun to add more supports and particularly for students with learning disabilities. These supports are individualized. While not everybody gets them, students who need them get them when they want them.

In a study of 109 very severely learning disabled students, we looked at what would happen when students read novels in this new format, digital with enhancements for their needs.

The results were stunning. Students who used the digital text found them more accessible, enjoyable and empowering than traditional books and by the way, so did their teachers. And they learned learning comprehension strategies much more effectively showing highly significant improvements, achieving half a year's progress after reading only three novels.

Remember again, these are students that have not been learning a great deal at all about reading. And those showed up on later standardized tests of reading comprehension. The control group showed virtually no progress at all with traditional books. Further, where this approach has been used, students exhibited fewer behavior problems because they were engaged in the learning activity itself and felt success.

Where do schools find books like this? Concord is making its own. This is a local and far too inefficient solution. Many schools across the country are doing the same thing resulting in an enor-

mous duplication of efforts as schools all across the country are beginning to make their own digital versions.

School districts and national publishers also face a bewildering and contradictory array of local requirements and formats for such digital technologies. Local solutions cannot work.

A new piece of proposed legislation, The Instructional Materials Accessibility Act of 2001, is critical. This bill provides for the establishment of a single national electronic file format to be used by publishers when creating electronic versions of texts.

A consistent standard will greatly facilitate the timely and efficient conversion of textbooks into digital versions that are accessible to students with disabilities: Braille, large print, digital audio and many other specialized versions like the ones I have mentioned.

The proposed bill further calls for a national electronic file repository, a central and efficient solution to replace a hodgepodge of local homemade products.

OSEP, under part D of IDEA, is supporting efforts that further the development of digital curriculum. For example, OSEP funds The National Center on Accessing the General Curriculum housed at CAST where research, design, development, dissemination and training related to digital, accessible curriculum materials can be furthered.

We hope that Congress will urgently expand this kind of sustained and systematic work. I have three recommendations in this area: Congress should support The Instructional Materials Accessibility Act; Congress should support dissemination and training for teachers, administrators and parents in using better digital materials and Congress should support ongoing research and development to make better and better digitally supported materials for students.

Lastly, and probably most importantly from our perspective, is the universal design of learning technologies. Making traditional books and printed materials accessible via new technology is necessary now, but it is not a sufficient step if all learners are to find the opportunities they deserve. In effect, we are still using new technologies to do old things. My colleagues in this panel have been describing and supporting ways to use powerful new technologies to do new things, to engage all students in active experimentation at a level that is not possible in traditional classrooms; to communicate about learning with the students all over the world, to evaluate their own learning, to construct problem solutions in social groups and on and on. These technologies are rightly preparing students for their future.

Unfortunately, the design of most of these learning technologies does not consider students with disabilities. As a result innumerable new barriers for students with disabilities are being created inadvertently as we speak. These powerful new learning technologies are in their infancy and as yet unformed. Once formed, disseminated and in wide use, these technologies will have to be retrofitted, or new assistive technologies designed to overcome the new barriers being designed while we are discussing these issues.

An analogy well known to members of this panel will illustrate my point. A number of years ago the new technology of television

was inaccessible to viewers who were deaf. Eventually decoder boxes to display captions improved access to television for deaf viewers. The cost of this retrofitted technology, several hundred dollars per television, still excluded many people. Legislation requiring televisions to include caption display technology led to the development of small decoder chips costing pennies apiece that were included in all the new televisions. And the beneficiaries of this quality, efficient technology include not only those that are deaf, but hearing individuals in gyms, noisy airports, spouses retiring at different times and individuals learning English as a second language.

The concept of building accessibility into learning technologies from the start is an example of what we call Universal Design. Well-executed universal design leads to less expensive solutions and better outcomes.

For the recommendations I make regarding universal design of learning technologies, Congress should require that any educational technology developed, maintained, procured or used by the Federal Government should be universally designed. And I have several other recommendations on my printed transcript.

In summary, I want to say I commend the Congress for its leadership and its commitment to students with disabilities. Fundamental to this commitment, and to all things I have recommended, is leadership implicit in IDEA. I strongly support the commitment to fund this important legislation.

In the innovative area of educational technology it is essential not only to provide support under part B of IDEA, it is also essential to fund discretionary programs for the kinds of technology research, training and dissemination I described.

PREPARED STATEMENT

And lastly, the over-arching recommendation I make to you is that we extend the same kinds of protections now afforded to physical spaces and to information in the workplace to a new area, the most important space for our future, the learning space. Our future as a culture depends on us making learning spaces, those precious spaces, accessible and supportive to every student. I believe that if we make the learning spaces of our schools accessible to all of our children, we will save both the short-term costs of poorly educating our children at the present and the long-term costs of not educating them for their future. This approach will save resources, but most importantly, it will save children.

Thank you very much for your attention.

[The statement follows:]

PREPARED STATEMENT OF DAVID H. ROSE

Mr. Chairman, and Members of the Subcommittee, it is an honor to be asked to testify at this important hearing on Education and Technology. My name is David Rose and I am the co-executive director of CAST, the Center for Applied Special Technology. I welcome the opportunity to speak with you today. The fact that I have been asked to testify on the educational technology needs of disabled students demonstrates that Congress understands how essential new educational technology is for ALL students.

Members of this committee were central to the passage of numerous pieces of landmark legislation over the past 30 years. Section 504 of the Rehabilitation Act of 1973, the Individuals with Disabilities Education Act of 1975, Section 508 of the

Rehabilitation Act of 1988 and 1998, and the Americans with Disabilities Act in 1990 are all landmark pieces of legislation. Because of these laws, many things formerly thought to be impossible for individuals with disabilities are now not only possible, they are commonplace.

Among those commonplace results is the fact that individuals with disabilities now have a right to a free appropriate public school education, and can expect to find educational buildings that are physically accessible to them. It remains a tragedy, however, that the curricula—the materials and methods for learning inside those buildings—are too frequently NOT available or accessible to students with disabilities.

At this moment in history, when innovative new educational technologies are being designed and distributed to classrooms, there is a unique and urgent opportunity to right this injustice. If this opportunity is seized, the future will see disabled people making contributions to our society that were envisioned with the passage of these landmark pieces of legislation. Moreover, the strategic appropriation of funds at this time will result in more effective use of educational dollars and a subsequent reduction of people having to go onto SSI and SSDI programs because they are not qualified to work in the jobs of the future. The overall benefits will be shared not only by children with disabilities, but by ALL children.

ASSISTIVE TECHNOLOGIES AND THE PRESENT

Most of the existing successes of technology for individuals with disabilities are examples of "adaptive" or "assistive" technologies. Assistive technologies are applications (either hardware or software) that are developed specifically to assist disabled individuals in overcoming barriers. We are all familiar with spectacular examples of these technologies:

—Matthew, 3rd grader with physical disabilities who cannot use his arms or legs, uses electronic switches to drive a wheelchair and operate his computer to write and communicate.

—Katherine, a 6th grader who is blind, uses screen reader technologies to navigate the Internet and do her social studies homework.

—Nina, who has a brain injury that causes her to be aphasic, uses an electronic augmentative communication device to speak to her friends and collaborate on schoolwork.

And there are even more spectacular assistive technologies under development, including ones that are more centrally placed in the nervous system—implanted technologies for hearing, for vision, for control of paralyzed muscles. These are essential uses of technology for individuals with disabilities and their continued development will require sustained federal support. There is simply not enough profit in these "low incidence" students to attract the strengths of the private sector.

Therefore, I recommend that Congress should continue to fund IDEA Part D research and technology development to ensure that new assistive and augmentative technologies are developed, particularly those that interface with new learning technologies (see below) and those that support cognitive as well as sensory and physical access. In addition, congress should support, through technical assistance grants or contracts, the training of assistive technology specialists so that every school district has access to trained individuals who can teach children to use these powerful technologies in a timely fashion, can assist their parents in understanding and advocating for their use, and can assist teachers and administrators in being effective consumers and implementers of these technologies.

That recommendation notwithstanding, there is a danger in viewing assistive technology as the sole focus of technology for students with disabilities. Such an orientation places the emphasis of intervention on the individual rather than the environment. While developing powerful technologies for overcoming barriers is a good thing, it must be balanced by designing environments that have fewer barriers. The lesson of the ADA is that small affordances built in everywhere, like curb cuts and ramps, are as essential as powerful motorized wheelchairs.

The same is true for educational materials and methods. We need to use the new technologies not only to overcome existing barriers to learning, but to design environments for learning that have fewer barriers right from the start.

MOVING TOWARD THE CENTER: THE POWER OF DIGITAL CONTENT FOR STUDENTS WITH DISABILITIES

In the Concord, New Hampshire public schools, teachers and parents have recently completed the painstaking task of copying all of their printed curricular materials into the computer. They now have their own "digital versions" of virtually

every textbook and printed text used in their schools. Why did they go to all that bother?

They did it because the digital versions of the books are much better for students with disabilities. The difference is not in the content—the digital versions have exactly the same content—the difference is in the way that content is displayed.

In print versions the content is dried into the paper, and its display is fixed, immutable, "one size fits all." In digital versions, on the other hand, content is presented dynamically on a computer screen. As a result, the power of the computer can be used to display the content in ways that are highly variable, malleable, and individualizable.

Imagine, for example, a digital version of "To Kill a Mockingbird" for a 10th grade classroom:

—Sarah, a student with low vision, can display the text in a very large font so she can see it;

—Bill, a student who is blind can have the computer display the text as spoken words or have the computer produce it as refreshable Braille;

—Jennifer, a student with severe physical disabilities can change the display (e.g. turn the pages) with a single blink of her eye;

—Michael, a student with dyslexia, can click on a difficult word to have the computer read it aloud.

In these simple ways, digital versions of traditional curricular materials can effectively reduce barriers to learning and reduce the costs associated with more expensive adaptations and pull-out programs. But it is possible to do more than merely reduce barriers. In a recently completed research study (with technology developed under support from U.S. Department of Education's Office of Special Education Programs), colleagues at CAST digitized books from local schools and, using the flexibility of digital text, embedded research-based strategies for improving reading comprehension. Nearly all of the students (109) in the study had learning disabilities and were performing at least two grade levels below their peers. Because of the digital texts, the level of access and support for reading comprehension could be adjusted closely to each child—providing the foundation for highly efficient learning.

The results were stunning—the students who used the digital texts not only found them more accessible (and enjoyable and empowering) than students who used traditional books, they learned reading comprehension strategies much more effectively than their peers, and they showed highly significant improvements (achieving a half year's progress after reading only three novels) on later standardized tests of reading comprehension. Their peers without such digital books did not show any significant progress at all. Further, where this approach was used, students exhibited fewer behavioral problems because they were engaged in the learning activity.

Where can schools get these kinds of digital books? Local solutions are far too inefficient. While many schools across the country, like Concord, have begun to digitize their own books, the duplication of effort is staggering. And it will get worse: most schools are not yet aware of this capability. The problem is further exacerbated, particularly for national publishers, by a bewildering and contradictory array of local requirements and formats.

A new piece of legislation, the Instructional Materials Accessibility Act of 2001, is critical. This bill provides for the establishment of a single national electronic file format to be used by publishers corresponding to texts they publish. This will greatly facilitate the timely and efficient conversion of textbooks into versions that are accessible to students with disabilities: e.g. Braille, large print, digital audio and other specialized formats like those that I have been describing. The bill further calls for a national electronic file repository—a central and efficient solution to replace a hodge-podge of local ones. CAST is already in the process of developing and launching a major national Web-based resource—The Universal Learning Center—to provide accessible digital curriculum materials to teachers and parents.

Having digital, accessible, learning materials in the schools is essential. Two other things are essential to ensure success. Most teachers are now unaware of, and unprepared for, the power of digital resources like these. Congress must ensure that there is support for the national training and dissemination of teachers, administrators, and parents in using these more efficient ways of making the curriculum accessible.

And it is also important to understand that we have only begun to exploit the power of digital resources: Congress should support ongoing research and development designed to develop and implement digital curricula that are infused with the best of research-based accommodations and enhancements for individuals with disabilities and their peers.

Projects funded under OSEP from part D funding of the IDEA (e.g. the National Center on Accessing the General Curriculum housed at CAST) are already making

progress on each of these points, but I recommend that Congress intensify these efforts lest we miss the opportunity before us. These efforts will ultimately save resources, and they will save children.

BUILDING A BETTER FUTURE: UNIVERSAL DESIGN OF LEARNING TECHNOLOGIES

Making traditional books and printed materials accessible via new technology is a necessary, but not sufficient, step: in effect it is using new technologies to do old things.

The more powerful new learning technologies, those that my colleagues on this panel have been describing, use the new technologies to do NEW things—to engage ALL students in active experimentation at a level impossible in "traditional" classrooms, to communicate about learning with other students all over the world, to evaluate their own learning, to construct problem solutions in social groups, to create and edit new kinds of media well beyond the limits of writing text. These technologies prepare students for their future.

Unfortunately, most of these learning technologies are not being designed with students who have disabilities in mind. As a result, these new technologies are likely to create new barriers for students with disabilities, leaving disabled children farther behind.

This is what I meant earlier by the urgency of the opportunity in front of us. We are at the infancy of these new learning technologies; they are not yet crystallized. Once they have been "hardened" and disseminated, it will be very expensive and wasteful to retrofit accessibility into them or to build new assistive technologies to overcome the barriers they impose.

An analogy well known to members of this panel is important. Several decades ago television, a new technology, was completely inaccessible to individuals who were deaf. Over time, decoder boxes were developed that individuals could buy to put on their televisions and see captions. These retrofitted technologies were expensive, purchased at hundreds of dollars apiece. Later, important legislation was passed to require that the design of televisions include a decoder chip, a small piece of accessibility that is now built into every television at only pennies a television. The result is higher quality, cheaper accessibility for individuals who are deaf. But there is an additional benefit. The heaviest use of captions is not by deaf people at all—but hearing individuals in noisy bars and airports, individuals who are English language learners, exercisers in gyms and so forth.

The concept of building accessibility into the technology from the start is an example of what is called Universal Design. It is generally better and cheaper to practice universal design than to retrofit solutions later. So, at this moment, when we are building new technologies for learning, we need to ensure that they are universally designed

It is important to reflect on the recent history of Section 508. Most government websites were originally created with no awareness of disability access. Since the law was passed making it essential to design carefully, there has been enormous expense to retrofit sites. What can Congress do to ensure that the new technologies are universally designed right from the start?

First, Congress can take the same kind of leadership as it did in legislating 508 for the workplace—in this case in the "learning place." Congress should require that any educational technology developed, maintained, procured, or used by the Federal government should be universally designed. Secondly, congress should require that all educational programs administered or supported by the federal government use universally designed educational technology. These actions by themselves would send a clear message that, like 508, would extend throughout the larger education community.

Second, to ensure rapid dissemination of better educational technologies, Congress should support the development of research-based guidelines for school districts, publishers, parents, and administrators on how to evaluate and select universally designed educational technologies.

Third, provide funding for continued research and development in designing, implementing, and integrating better universally designed educational technologies.

SUMMARY

I commend the Congress for its leadership and its commitment to students with disabilities. Fundamental to this commitment, and to all of the things I have recommended, is the leadership implicit in IDEA. I strongly support the commitment to fully fund this foundational legislation for our future.

In the innovative area of educational technology it is essential not only to provide the kinds of support provided under Part B of IDEA, it is essential to fund discre-

tionary programs that enable technology research, training, and dissemination—those under Part D. Without that support we will miss the opportunity, just at this propitious moment, to turn the power of educational technology in a direction that will indeed leave none of our children behind.

In specific, I have made recommendations in three areas:

(1) *Assistive technologies*.—These individual technologies are essential to overcome the barriers that students with disabilities face in normal classrooms. Congress should support their continued development into areas where barriers remain, and should fund technical assistance to school districts so that they can be effective consumers of these powerful technologies.

(2) *Digital Curricula*.—Most existing classroom technologies are still print based—making it very difficult to use assistive technologies, and even more difficult to individualize the curriculum in ways that are necessary for students with disabilities. I recommend that Congress provide legislation so that every piece of curriculum is made available in digital format so that it can be easily customized and made accessible for all students and that Congress fund a central place for teachers and parents to locate these resources.

(3) *Universal Design of Learning Technologies*.—As new technologies are developed for schools, they should be made accessible to all of the students in the school, right from the start. Congress should support efforts to make guidelines for the universal design of such technologies and provide leadership in purchasing, maintaining, and disseminating such technologies in all of its programs.

The over-arching recommendation that I make to you is that we extend the same kinds of protections now afforded to physical spaces and to information in the workplace to a new area, the most important space for our future—the learning space. Our future as a culture depends on us to make the learning spaces, those most precious spaces in the lives of our children, accessible and supportive of every single child. I believe that if we make the leaning spaces of our schools accessible to all of our children, we will save both the short-term costs of miss-educating our children in the present and the long-term costs of NOT educating them for their future.

Senator HARKIN. Thank you very much, Dr. Rose. I was just making some notes on this. Thank you all. This has been great testimony and I appreciate your being here and for your involvement in this.

I would like to start out first by talking with Mr. Gann about this concept that I think you brought to my attention a few weeks ago about the idea that we may be going down the wrong road if we are going to be focusing on a PC on very desk. We have had other testimony about how much money is going into hardware. These get outdated and they have to be upgraded all the time. You have a different concept. Your concept is—what did you call it—backend?

Mr. GANN. Well, you could call it network centric computing or Internet computing.

Senator HARKIN. Yes. Flesh that out for me a little bit more. What you are talking about is some kind of a web-based system that would be district-wide based; maybe State-wide based? I am uncertain as to how large an area you would cover with this.

There would be servers in the schools, but would not the kids still have to have some type of a terminal of some kind, either a PC or something that they would have within their classroom. You are not getting around the hardware. You may be getting around some of the software problems, but I do not know about the hardware problems. I am a little hazy as to how this is going to save us money and be more quickly upgradeable in the future, so could you talk about that a little bit more?

Mr. GANN. Sure. Well, I think a really good analogy to begin with would be when you go on the Internet today and you go to a site such as Yahoo!, that site has all the data aggregated for you. In effect, it is a portal. And what is really great about a site like that

is that you can use really any number of devices, a PC, or a network computer. Even Palm Pilots today, these inexpensive handhelds, have Internet capabilities that can enable you to log into a portal like this. What is important about this approach of network computing, if you will, is that the intelligence is invested at the backend in servers and storage devices and in software. And it is based on open systems and open standards. What is really important here is simply by using a browser, whether from Microsoft or Netscape, whoever, you can access all of this data very easily and what is really important is that it becomes a lot less important what type of device you are using from a user point of view. So you can use a PC that is current today, you can use an older PC, you can use other devices, but what is important is that they are hooked into the Internet with the browser and that very fact of interoperating with the smarter system gives schools more choices. So to conclude, you absolutely will have a role for PC's. It is just that PC's and other devices can be used longer and more effectively if they are Internet-enabled with browsers. One of the things that we see is that older PC's, you know an old Pentium machine, we have even seen 486 machines that are sort of being given away for free now, can be significantly refurbished and used in schools if you put good browsers on them and you really hook them into a powerful backend.

So it is all about using more devices effectively.

Senator HARKIN. Is this being done anywhere?

Mr. GANN. Sure, it is being done a lot in the private sector——

Senator HARKIN. I mean in education.

Mr. GANN. It is also being done in a number of schools. There is a grade school in Carrolton, Georgia where they have implemented this. There is also a school in Florida called The Celebration School, and a school in California in Newark.

Senator HARKIN. So your advice to us is as we move ahead in this—are you saying that perhaps by giving a block grant out to the States, that States may take this money and give it to local school districts and in each local school district they have all the sales people come around and they have got this system and that system and this system, and so you have a lot of different systems operating in say, one State, for example? Are you suggesting that what we might want to do is to try to move more in the direction of standardization or something of a backend system? Not telling what kind of backend system they have to have, but saying that this is where we want the money to be used; not just in buying laptops and buying software programs on an individual basis—individual school district basis, but doing it on a broader statewide basis. Is that what you are saying, what we ought to be doing is giving that kind of direction?

Mr. GANN. Well, I think one thing that would be very useful is to help fund some pilots around the country to experiment with new innovations and technology, and I think there are a couple of really important rules that need to apply. One is it tends to be better when vendors work with open systems and standards. That ensures that any number of devices, any number of technologies from different vendors can work together. That way schools do not get locked into any one technology.

The second piece of advice is if you put the technology more and more in the backend and focus it on the Internet, you can get some of the economies of scale that we have been talking about. So I think it is good to do some pilots and it is good to do some learning to see what really works well.

Senatro HARKIN. How about the rest of you? You've all been involved in this. You've all had kind of specific things here, but I think Mr. Gann is putting his finger on a divergent path that we may be going down. We are going to go one way or the other. If we decide to go one way, it is going to be hard to shift to the other, if you see what I mean. Once you start going down that path, I think it is going to be hard to shift over. So how do you feel?

Now, Ms. Maxwell, you've been involved in a site-specific, school-specific program where they are not networked outside the school, but they are in those classrooms. They have got their individual programs, and what Mr. Gann is talking about is something where those students would be hooked up to a server. They would be able to tap into a broader base of information than perhaps they have right now. Just from your 1 year of experience in this, how do you think that this might be better or worse than what you are doing right now?

Ms. MAXWELL. We have not locked ourselves into stand-alone situations. We are networked to a server and we do use the Internet, actually, probably more than software. I am not quite understanding, Mr. Gann. Are you going to be like a portal where you already have these sites available, or software available? I am not quite with what you are——

Mr. GANN. Well, one of the things that we are seeing, actually, in the industry is a lot of the mainstream publishers, McGraw Hill, and other vendors are moving to a more network-enabled kind of environment. In fact, back here at our demo, a number of the vendors are showing off technology such as PLATO and Carnegie Learning that are moving to a more open web-enabled environment. So I think what is important here is that a lot of the traditional technologies can be re-engineered to get the benefit of the Internet while still working with existing systems such as PC's which, make no mistake, are still very effective tools.

Ms. WILLIAMS. It is my impression that what you are talking about is technological backend with which I am not familiar, but what is true, as Gail said, is that most schools are working in a network environment, not a stand-alone environment. And the biggest challenge that they are having now is the bandwidth problem.

Senator HARKIN. Is a what?

Ms. WILLIAMS. Bandwidth. So if you have—let's just say you have a school that has a very low computer-to-student ratio, so you have a possibility of having a lot of kids on line at the same time and the barrier is that the information just does not come up fast enough where you cannot navigate it fast enough, but they are already working in a highly networked environment since——

Senator HARKIN. Networking into schools or outside?

Ms. WILLIAMS. Oh, outside. Yes. Because that is the whole point. They are doing a lot of interacting with other children or with experts through just plain old e-mail.

Senator HARKIN. But what are they networking with? With whom? With what?

Ms. WILLIAMS. To information resources on the web.

Ms. MAXWELL. Exactly.

Senator HARKIN. OK.

Ms. WILLIAMS. We use very little stand-alone software unless it is a project-based software where we—like word processing or desktop publishing. We are linked to the Internet. We do a lot of what are called WebQuests, where we use—the students are involved in projects that access sites on the Internet to perform a task and solve a problem. So most of our usage is already using the Internet and going out to sites all over the world and like she said, to look at experts, or talk to experts, or to do e-mail with other students in other schools. That is what we are doing a lot of already with project-based learning.

Senator HARKIN. Well, the question I have on that is number one, is it reliable? First of all, you never know who you are talking to on the Internet. Is it reliable? Has it been developed to a curriculum-based type of evaluation? Obviously, we all go on the Internet and do all kinds of things. But my question is, is having programs that are web-based, as Mr. Gann is talking about, is that geared toward education, towards all aspects of education? That is quite different than just getting on the web now and surfing all around and finding this and that.

Ms. MAXWELL. We do not have the students just out there surfing the Internet. Everything we do is very structured and that is where the time comes in on the teacher's part and myself. We do all of that searching and looking for good educational sites that are sound and accurate, ahead of time. That is where the WebQuests are an excellent source because those are very structured and every site you go to has been checked and made sure that they are educationally sound. We make sure everything is tied to our objectives and standards before we do it.

Senator HARKIN. Dr. Honey.

Dr. HONEY. I think what we have seen in the last 8 years is that there has been a tremendous growth in educational content on the Internet and there has been a tremendous amount of development and schools like Ms. Maxwell's that are well poised to take advantage of those resources can use them very effectively.

But a much greater concern from my point of view is that not all schools are created equal. And we have growing, growing, growing disparities in this country, particularly between urban schools and better endowed, wealthier, suburban, often communities. The critical difference here is that in those communities people are either well poised to use the educational resources of the Internet, or not well poised to use them, and there is a widening gap.

So there are real issues around how do you help struggling districts, districts that are facing real serious achievement problems move in the direction of being able to take advantage of what has really become an enormous wealth of education resources.

Senator HARKIN. Now you are talking about another slice. That is another divergence that is taking place out there. In back of that, I am still trying to figure out whether—now what Mr. Gann, Ms. Maxwell and Ms. Williams were basically saying is that is al-

ready there. That backend architecture is already there that they can tap into. But from your testimony, it seems to me you are saying that, again, we must rethink the current computer in the classroom models and start thinking about the network architecture that could be employed by an entire school or school district.

A single PC on a classroom desk just does not cut it, with more emphasis placed on building long-term reliable backend architecture. This means focusing on the benefits of centralized technology and networking at districts that have computers, who are building systems with scalable servers, and on and on. The anytime/anywhere computing model relies upon an open system's architecture through which information is accessed and delivered via the Internet.

Well, they say it is already there.

Mr. GANN. Well, the good news is it already is there in a number of settings.

I think the bad news is there is still more work to be done. What tends to happen for better or worse is the private sector tends to move faster in terms of implementing technology than a lot of public sector environments and I think schools unfortunately, you know, have been crippled with all sorts of funding problems and other issues. And oftentimes, technology does not get quite the attention it should. But the short answer is that this wave towards network centric or web-based learning is happening. It needs to happen quicker.

I think the final thing in the real benefit of web deployment is that it enables applications that are tightly integrated, such that users can be accessible to the system in a greater variety of ways. So it is just really using Internet-type technologies to enhance communication.

Dr. HONEY. One other point to add to what Mr. Gann was saying in his testimony is that this point about the stand-alone $2,000 computer for every student is not realistic I think is very true and what I heard him saying is that we are seeing very rapid changes in that area where devices are becoming increasingly portable, increasingly smaller, Palm Pilots, IPAC's, all of those kinds of things can access the Internet at greatly reduced costs.

Ms. WILLIAMS. The other development that I am reminded of is that there are a number of States that have instituted State education network infrastructures just to help facilitate these kind of things, Mo/Net in Missouri, the Florida Education Research Network. So at a lot of State levels there has been more sort of subnetwork architecture, but there is a lot of use of the Internet in highly appropriate and mediated ways in schools. I know the example Ms. Maxwell gave us in the elementary school. But in secondary science education, I mean these students are going to primary resources, federally funded, The National Weather Service, NASA, USGS, and they are getting real-time data to use in building their knowledge base about how you do scientific inquiry and actually contributing to the scientific field in some ways as they enter their data into open data bases that are accessible internationally.

So there is work being done in that regard, and some really fine examples of its effectiveness.

Senator HARKIN. Let me get onto the bandwidth problem. In Iowa we do not have the problem. Do we, Ms. Maxwell?

Ms. MAXWELL. It is really good.

Senator HARKIN. We have no problem with bandwidth. We have a fiber optic system that goes to every—well, I should say it goes to every high school. We are now going to every grade school. I do not know how long that is going to take. That is going to take a little bit longer, but every high school has all the bandwidth they need with fiber optics in the State of Iowa at very low cost, because the State owns the system.

But that is not true in every State. And we do have that problem. How do you think the Federal Government ought to be involved in ensuring that elementary and secondary schools around the country have access to the broad highways? I want any thoughts you have on that. I mean we are putting this money in this Bill and we have—where is my table—but what happens we may be putting a lot of hardware in the schools, but we have got all this information here and you have got all the PC's out there and you have got some narrow little constrictor to go through. Tell me how we solve that.

Dr. HONEY. Well, two things, I would say. One is Cheryl Williams' comment about ensuring that the E-Rate monies continue to be available. They have been critically important in bringing bandwidth to schools.

And another initiative that is underway that the Federal Government surely can take a leadership role in is the development of Internet Two, which is now going on—I am sure Mr. Gann can speak more about this from Sun Microsystems' prospective—but it is taking place in a number of universities and a number of corporations in the country with Federal money, some of which I know comes from The National Science Foundation.

But there is now a movement underway to enable State networks to connect into the Internet Two backbone, which has a potential to bring greatly increased bandwidth to schools.

Senator HARKIN. I have to move on to the demonstration. My time is running out.

But Ms. Williams, all of your testimony was basically about that you strongly support the New Federal Education Technology Block Grant. Then you went on to talk about how all of the programs that we have had under the Federal system; The Technology Literacy Challenge Fund, The Technology Innovation Challenge Grants, The Teacher Training Technology, you mention these as being very successful programs.

Well, those are not in the block grant program. Well, one of them is, Teacher Training is in the block grant program. But The Technology Innovation Challenge Grants and The Technology Literacy Challenge Fund—do you mention that?

Oh, I am corrected. You did not mention The Technology Literacy Challenge Fund and The Technology Innovation Challenge Grants. Somebody else did here.

Ms. WILLIAMS. I think I did.

Senator HARKIN. But I am just wondering——

Ms. WILLIAMS. In a perfect world, we would love those programs to be continued as they are. We understand that we need to work

within the realities and it appears to us that there are many things that are underway with the Challenge Fund, which is administered by the States. And we are hopeful that the funding levels will remain the same so that the work that has been started can continue. I think that is the message.

Senator HARKIN. Any of you have any thoughts on The Technology Literacy Challenge Fund that we had and the technology grants at all? Again, if this is a block grant—I mean maybe they will do it and maybe they will not. I do not know.

Dr. HONEY. I think as a nationally run program, it has demonstrated incredible successfulness. I have served on The Expert Technology panel and I can tell you that many of the applications that rose to the top of what was a pretty comprehensive group of projects were originally seeded with monies from that program. It has allowed for tremendous innovation to take place in the education arena.

Ms. MAXWELL. As a recipient of one of those grants, they are great. But our concern is what happens when the grant runs out?

Senator HARKIN. I am sorry, Ms. Williams, you did mention—you said here, "Congress appropriated nearly $1.7 million for The Technology Literacy Challenge Fund and The Technology Innovation Challenge Grant, two Federal programs that support school district efforts to develop technology plans, acquire hardware and software and this Federal involvement has paid off. During this same period, student-to-computer ratios", et cetera, et cetera, you went on.

Again, I am not trying to challenge you. I am just trying to figure out whether or not we ought to just say we would leave it to the States to do this, or we actually keep these programs going.

In other words, the block grant could be this big and we say do with it what you want, or the block grant can be this big and we say, "but within that block you have to do these couple things". You see what I am saying?

Ms. WILLIAMS. I see exactly what you are saying.

Senator HARKIN. That is what you are saying?

Ms. WILLIAMS. What we were advocating within the realities of today was that the total funding not be diminished. I would concur with Margaret Honey that there has been huge innovation that has been learned and spurred through national programs that it would be wonderful to be able to continue to leverage through dissemination and other fashions.

It would be our hope that the whole effort around supporting innovation with education technology would not be diminished.

Senator HARKIN. Hopefully, we are not going to diminish it and will boost it even more.

One last thing. Dr. Rose, on Universal Design, who decides? I mean Universal Design is a wonderful concept, but it may mean different things to different people. Who decides that?

Dr. ROSE. Well, I think one of the things I recommended is I think more work needs to be done on the guidelines. In fact, I just want to say that I agree with Mr. Gann. I think that the centralized way is the way to do it. Then it is much easier at that level to say, "And here is what the guidelines are for what an educational environment on the web should look like", and it should be inclusive of all students. It is very much easier to do that.

The danger in block grants are that push from the national level to say, "And all of our educational curricula delivered on the web delivered in every way should have Universal Design, and here are the guidelines." Congress has supported the development of guidelines from our best people developing educational technologies to ensure that those benefits go to everybody.

Senator HARKIN. Yet do you think we should require—that was your word, I believe—that all curricula be digitally formatted?

Dr. ROSE. Yes.

Senator HARKIN. I am not sure I understand that.

Dr. ROSE. Well, that is sort of a bit of a retrofit, but present books really are very difficult for lots of students to learn from. And then we have to do a lot of expensive things to try to make them work. And what I am saying is that if we, in addition to having the printed book, have a digital version, which, in fact, they were originally made in digital version; but those are delivered safely to students and their teachers, and in fact, we can do that individualizing, say, well, Billy needs this book to read out loud because he is blind. And Sally is going to need help with the decoding because she is dyslexic. All of that can be done easily digitally. The printed book is very hard. We have to hire teachers, we have to send them to special resource rooms, and you have to do something else because of the fact that the book does not work very well.

In some States they are starting to do this, to say when you deliver us a curriculum, deliver us a digital version with it. And we just think that's the way to do it every time. It is a much more flexible version and much more accessible. It is delivering the ramps and curb cuts right with the book.

Senator HARKIN. You are focusing mostly on literacy, or on reading?

Dr. ROSE. I am, but I wanted to say that GBH is here and they have the same—it is true for videos, for audios, everything can be universally designed. I concentrate a little bit on the literacy here.

Senator HARKIN. Your advice is well taken. I think that we ought to think about putting something in there on Universal—is there anything in there on Universal Design? I think that is something I would be interested in if you or anyone here has any suggestions.

Dr. ROSE. We have a lot, actually.

Senator HARKIN. Well, better get them to us.

Dr. ROSE. OK.

Senator HARKIN. I would like to think about putting that in the legislation, I think. I mean I am going to think about it some more. But I like the concept of universal design. I think it saves going back and redoing things later on.

Dr. ROSE. Yes.

Senator HARKIN. It is just like now we are beginning to design architecturally buildings that are universally adaptable.

Dr. ROSE. Yes. It is a lot cheaper to do at the beginning. And it turns out to benefit everybody and that is true in education. If you universally design the curriculum from the start, it has things built into it that are just better for everybody, just like in architecture.

Senator HARKIN. Yes, because as I said at the beginning, I am really amazed at how much more the technology has done to help kids with disabilities learn. It is amazing what is happening.

Well, thank you all very much. I am now going to adjourn the hearing and then we are going to invite everyone to the back of the room to view demonstrations. We have eight companies demonstrating here, Break Through to Literacy, Microsoft, Carnegie Learning, PLATO Learning, Light Span, Apple and Power School, Wireless Generation and WGBH.

CONCLUSION OF HEARING

Thank you all very much for being here, that concludes our hearing.

[Whereupon, at 10:58 a.m., Wednesday, July 25, the hearing was concluded, and the subcommittee was recessed, to reconvene subject to the call of the Chair.]

○